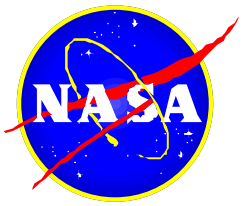

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas 77058

August 2003

System Requirements Document
for the
Human Research Facility
Mobility Hardware

REVIEW COPY
FOR CCB Control

LS-71116

PROJECT DOCUMENT APPROVAL SHEET

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System Requirements Document
for the
Human Research Facility
Mobility Hardware

APPROVED:	EB/Elizabeth Bauer Technical Manager
APPROVED:	NT3/V. Watkins GFE Assurance Branch
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System Requirements Document
for the
Human Research Facility
Mobility Hardware

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DOCUMENT NUMBER LS-71116	DOCUMENT CHANGE/ REVISION LOG	PAGE 1 OF 1

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Preface

This System Requirements Document (SRD) defines the minimum set of requirements for the Mobility hardware to be placed on the International Space Station (ISS) and used with Human Research Facility (HRF) equipment. This document is under the control of the HRF Configuration Control Board (CCB).

HRF CCB Chair DATE

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ACRONYMS AND ABBREVIATIONS

A	Amperes
AC	Alternating Current
ADP	Acceptance Data Package
AGP	Accelerated Graphics Port
APM	Attached Pressurized Module
Ar	Argon
ASC	Aisle Stowage Container
ATV	Automated Transfer Vehicle
AVT	Acceptance Vibration Testing
ºC	Degrees Celsius
C&DH	Command and Data Handling
CAM	Centrifuge Accommodation Module
CCB	Configuration Control Board
CFU	Colony Forming Units
CI	Cargo Integration
CIL	Critical Items List
cm	centimeters
CO2	Carbon Dioxide
COTS	Commercial-Off-The-Shelf
CSCI	Computer Software Configuration Item
CTBE	Crew Transfer Bag Equivalence
dB	Decibels
dBA	Acoustic Decibel Level
DC	Direct Current
DGCS	Display and Graphics Commonality Standard
dia.	diameter
DR	Discrepancy Report
DRD	Data Requirements Document
DRL	Data Requirements List
EEE	Electrical, Electronic, and Electromechanical
EMC	Electromagnetic Compatibility
EPCE	Electrical Power Consuming Equipment
EPS	Electrical Power System
ESD	Electrostatic Discharge
EUE	Experiment Unique Equipment
EVA	Extravehicular Activity
EWACS	Emergency Warning and Cautious System
ºF	Degrees Fahrenheit
fc	foot candle
FDS	Fire Detection System
FIAR	Failure Investigation Analysis Report
FMEA	Failure Modes and Effects Analysis
FPD	Flight Projects Division
GFCI	Ground Fault Circuit Interrupter

ACRONYMS AND ABBREVIATIONS (Cont'd)

GFS	Government Furnished Software
GIDEP	Government and Industry Data Exchange Program
GN2	Gaseous Nitrogen
GPVP	Generic Payload Verification Plan
GSE	Ground Support Equipment
He	Helium
HR	Hazard Report
HRDL	High Rate Data Link
HRF	Human Research Facility
Hz	Hertz
ICD	Interface Control Document
IDD	Interface Definition Document
IDE	Integrated Drive Electronics
IEEE	Institute of Electrical and Electronic Engineers
IMS	Inventory Management System
in	inch
IP	International Partners
ISIS	International Subrack Interface Standard
ISPR	International Standard Payload Rack
ISS	International Space Station
ITCS	Internal Thermal Control System
IVA	Intravehicular Activity
JEM	Japanese Experiment Module
JSC	Johnson Space Center
kHz	Kilohertz
kPa	KiloPascal
KSC	Kennedy Space Center
lb	pound
lbf	pounds force
LSDS	Life Sciences Data System
MDM	Multiplexer-Demultiplexer Module
MGD	Mobility Graphics Display
MGFS	Modified Government Furnished Software
MIL-ER	Military Established Reliability
mm	millimeter
MOTS	Modified Of the Shelf
MPLM	Mini Pressurized Logistics Module
ms	milliseconds

ACRONYMS AND ABBREVIATIONS (Cont'd)

MSFC	Marshall Space Flight Center
MUA	Material Usage Agreement
MVAD	Mobility Visual Acuity Display
N	Newton (metric force measurement)
NASA	National Aeronautics and Space Administration
ORU	Orbital Replacement Unit
Pa	Pascal
para.	paragraph
PDA	Pre-Delivery Acceptance
PFE	Portable Fire Extinguisher
PHTR	Packaging, Handling, and Transportation Records
PI	Principal Investigator
PIA	Payload Integration Agreement
P/L	Payload
PODF	Payload Operations Data File
PRACA	Problem Reporting and Corrective Action
PRD	Program Requirements Document
psi	pounds per square inch
psia	pounds per square inch absolute
PSRP	Payload Safety Review Panel
PU	Panel Unit
QEPM&L	Qualified Electrical, Electronic, Electromechanical (EEE) Parts, Manufacturers, and Laboratories
QAVT	Qualification for Acceptance Vibration Testing
Rad	Radiation Absorbed Dose
RGB	Red, Green, Blue
RMA	Reliability, Maintainability and Availability
rms	root mean square
RPC	Remote Power Controller
RPCM	Remote Power Controller Module
RSP	Resupply Stowage Platform
RSR	Resupply Stowage Rack
SEE	Single Event Effect
SE&I	Systems Engineering and Integration
sec	second
SIR	Standard Interface Rack
SLPM	Standard Liters Per Minute
SOW	Statement of Work

ACRONYMS AND ABBREVIATIONS (Cont'd)

SPIP	Station Program Implementation Plan
SPL	Sound Pressure Level
SRD	System Requirements Document
SUP	Standard Utility Panel
SVT	Science Verification Testing
TBD	To Be Determined
TBR	To Be Reviewed
TCS	Thermal Control System
TM	Technical Memo
TPS	Task Performance Sheet
TVIS	Treadmill Vibration Isolation System
UIP	Utility Interface Panel
UOP	Utility Outlet Panel
USB	Universal Serial Bus
USL	United States Lab
V	Volts
Vdc	Volts direct current
V	Volts
VC-S	Visibly Clean-Sensitive
VDS	Verification Data Sheet
WSTF	White Sands Test Facility

1.0 SCOPE

This specification defines the Human Research Facility (HRF) program requirements for E120 Mobility. Mobility consists of Criticality 3 Experiment Unique Equipment (EUE) hardware and software that will be used to support the HRF. The term "Experiment Unique Equipment," as used in this document, is defined as hardware designed to support an HRF Program experiment and not intended for general use.

The primary governing document for the requirements levied in this document is LS-71000, Program Requirements Document for the Human Research Facility. Other requirements are derived from the experiment unique interface definition documents for the various items of HRF equipment.

The requirements in Sections 3, 4 and 5 of this document consist of a minimum set of constraints for Criticality 3 EUE hardware and software. Criticality 3 items are defined in the table in Section 3.2 of LS-71000.

The HRF Project Office is the controlling authority for this document. The HRF Configuration Control Board (CCB) or a delegated authority must approve any deviations from the requirements of this document. Any change in EUE functionality that requires equipment designated as Criticality 3 to be used in a manner that is not consistent with the requirements specified herein and in LS-71000 will require a reassessment of the item or items for criticality level as well as a reevaluation of applicability to this document.

2.0 APPLICABLE DOCUMENTS

The following applicable documents of the exact issue shown herein form a part of this specification to the extent specified herein. If a revision level or date is not cited, the latest version of the document should be used.

All specifications, standards, exhibits, drawings, or other documents referenced in this specification are hereby incorporated as cited in the text of this document.

Any updated revisions to documents specified herein shall be reviewed to determine the impact to the design. Changes to the design or this document shall only be made upon the direction of the HRF CCB.

2.1 DOCUMENTS

Document Number	Revision	Document Title
FED-STD-595	Rev. B 12/89	Colors Used in Government Procurement
JPD 5335.1	Rev. E	JSC Quality Manual
KHB 1700.7 Handbook	C 8/99	Space Shuttle Payload Ground Safety
LS-71000	Rev. B	Program Requirements Document for the Human Research Facility
LS-71011	Rev. A 10/01	Acoustic Noise Control and Analysis Plan for Human Research Facility Payloads and Racks
LS-71014	Draft 9/26/97	Mass Properties Control Plan Human Research Facility Payload and Racks
LS-71016	Rev. A 08/29/01	Electromagnetic Compatibility Control Plan for the Human Research Facility
MIL-A-8625	09/93	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-PRF-19500	Rev. M 10/99	Performance Specification Semiconductor Devices, General Specification for
MIL-STD-1686	Rev. C 10/95	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
MSFC-STD-531	09/78	High Voltage Design Criteria
NASA-STD-6001	2/98	Flammability, Odor, Offgassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion
NASA TM 102179	6/91	Selection of Wires and Circuit Protective Devices for STS Orbiter Vehicle Payload Electrical Circuits

Document Number	Revision	Document Title
NHB 6000.1C	C 6/76	Requirements for Packaging, Handling and Transportation for Aeronautical and Systems, Equipment, and Space Associated Components
NSTS/ISS 13830	Rev. C, Ch. 5 3/03	Payload Safety Review and Data Submittal Requirements For Payloads Using the Space Shuttle and International Space Shuttle
NSTS/ISS 18798	Rev. B, Ch. 7 2/00	Interpretations of NSTS/ISS Payload Safety Requirements
NSTS-1700.7	Rev. B, Ch. 14 3/03	Safety Policy and Requirements For Payloads Using the Space Transportation System
NSTS-1700.7B ISS Addendum	Basic, Ch. 6 3/03	Safety Policy and Requirements For Payloads Using the International Space Station
NSTS-21000-IDD-MDK	Rev. B, Ch. 15 10/02	Shuttle/Payload Interface Definition Document for Middeck Accommodations
NT-CWI-001	Rev. A, Chg 2 07/31/01	Task Performance Sheet (TPS)
SAIC-TN-9550	12/01	Ionizing Radiation Dose Estimates for International Space Station Alpha using the CADrays 3-D Mass Model
SN-C-0005	Rev. D, Chg 8 1/03	Space Shuttle Contamination Control Requirements
SSP 30223	G 4/98	Problem Reporting and Corrective Action Space Station Program
SSP 30233	Rev. F 7/99	Space Station Requirements for Materials and Processes
SSP 30237	Rev. F, Chg 20 3/02	Space Station Electromagnetic Emissions and Susceptibility Requirements
SSP 30240	Rev. D 12/02	Space Station Grounding Requirements
SSP 30242	Rev. E, Chg 3 8/99	Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility

Document Number	Revision	Document Title
SSP 30243	Rev. G Ch. 13 5/03	Space Station Requirement for Electromagnetic Compatibility
SSP 30245	Rev. F 7/03	Space Electrical Bonding Requirements
SSP 30257:004 Activity Standard Interface	E 11/96	Space Station Program Intravehicular Restraints and Mobility Aids Control Document
SSP 30312	Rev. G 10/00	Electrical, Electronic, and Electromechanical (EEE) and Mechanical Parts Management and Implementation Plan for Space Station Program
SSP 30423 Electronic, Parts Lists	F 11/95	Space Station Approved Electrical, and Electromechanical
SSP 30512	Rev. C 9/94	Space Station Ionizing Radiation Design Environment
SSP 30695	A 1/95	Acceptance Data Package Requirements Specification
SSP 41017	Rev. F 1/02	Rack to Mini Pressurized Logistics Module Interface Control Document (ICD) Part 1
	Rev. G 1/01	Rack to Mini Pressurized Logistics Module Interface Control Document (ICD) Part 2
SSP 50005	Rev. C, Ch. 8 9/01	International Space Station Flight Crew Integration Standard (NASA-STD-3000/T)
SSP 50467	11/00	ISS Cargo Stowage Technical Manual: Pressurized Volume
SSP 52005	Rev. B 3/99	Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures
SSP 57000	Rev. E 4/00	Pressurized Payloads Interface Requirements Document
SSP 57001	Rev. C 10/00	Pressurized Payloads Hardware Interface Control Document Template
SSQ 25002	Rev. A, Chg 6	Supplemental List of Qualified Electrical, Electronic and Eletromechanical (EEE) Parts, Manufacturers, and Laboratories (QEPM&L)

2.2 ORDER OF PRECEDENCE

In the event of a conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3.0 SYSTEM REQUIREMENTS

3.1 ITEM DEFINITION

The following items of E120 Mobility (MOB) EUE will be designed and certified under this requirements document for use on ISS as a part of the HRF program. HRF hardware used with this experiment is certified under separate documentation, which is maintained by the appropriate program(s).

Table 3.1-1 lists the equipment items covered by this document, including the stowage kits that will be used to transport the items and contain the items on-orbit.

TABLE 3.1-1. MOBILITY EXPERIMENT UNIQUE EQUIPMENT

Item Name	Part Number	Notes
Mobility Graphics Display (MGD)	TBD	Touch Screen LCD Monitor driven by embedded computer.
Mobility Visual Acuity Display (MVAD)	TBD	
MOB Power Cable	TBD	
MOB Mounting Bracket	TBD	
MOB Mouse	TBD	
MOB IDE Drive	TBD	

3.1.1 Experiment Description

3.1.1.1 Experiment Overview

The goal of this study is to develop an in-flight treadmill training protocol that enhances adaptive generalization of locomotor function, facilitating rapid and robust recovery of functional mobility after long-duration space flight. The approach is integrated with the existing International Space Station (ISS) treadmill procedures creating a unified, multi-disciplinary countermeasure system designed to enhance post-flight locomotor function. Systematically manipulating body load, speed and visual tasking during treadmill locomotion requires subjects to repeatedly formulate new sensorimotor solutions to dynamic transitions in locomotor behavior during treadmill exercise. The Principal Investigator (PI) team anticipates that this training protocol will enhance locomotor response generalizability, facilitating locomotor adaptive transition from microgravity to partial (Mars) or unit (Earth) gravity environments following space flight. Video-based motion analysis will be used to measure head and body kinematics and eye movements before and after space flight to determine the efficacy of the countermeasure.

3.1.1.2 Operational Overview

Subjects will perform the in-flight treadmill training protocol using Mobility Graphics Display (MGD) during the warm-up and cool-down periods of the crewmembers regularly scheduled in-flight treadmill exercise protocols. This session will involve systematic variation of treadmill speed, body load, and visual

tasking during treadmill locomotion. The specific combination of speed, load and visual task will vary within each session as well as vary from session to session. Three sessions of this type will occur weekly for approximately 10 minutes during warm-up and 10 minutes during cool-down.

One time each week, before beginning the in-flight treadmill training protocol, subjects will stand approximately 50 cm in front of Mobility Visual Acuity Display (MVAD) for 5 minutes and recognize and respond to a series of Landhotz C's presented on the screen. This test is then performed again while the subject is walking on the ISS treadmill at 6.4 km/h for 5 minutes.

3.2 CHARACTERISTICS

3.2.1 Performance Characteristics

3.2.1.1 Functional Performance Characteristics

3.2.1.1.1 Video Formats

Mobility shall display video and output audio from the following video storage formats:

A. CDROM
B. DVD-R
C. DVD-R/W

3.2.1.1.2 Mobility Graphics Display Characteristics

A. MGD shall have a diagonal viewing area greater than or equal to 22 inches.
B. MGD shall support at least the following resolutions with the MVAD operating simultaneously:
    1. 1600 x 1200
    2. 1024 x 768
    3. 800 x 600
    4. 640 x 480
C. MGD shall have integrated touch screen capability.

3.2.1.1.3 Mobility Visual Acuity Display Characteristics

A. MVAD shall have a diagonal viewing area greater than or equal to 1.3 inches.
B. MVAD shall support a display resolution of 640 x 480.
C. MVAD shall have a dot pitch less than 0.120 mm (many grayscale levels) at the resolution in 3.2.1.1.3.B.

3.2.1.1.4 Audio Output Characteristics

A. Mobility audio output shall be in stereo.
B. Mobility shall output stereo audio via headset or auxiliary speaker.

3.2.1.1.5 Data Storage

Mobility shall store subject responses via Mobility Mouse for:

A. 10 minutes per session
B. 2 sessions per protocol
C. 1 protocol per week, per crew member
D. 210 days

3.2.1.1.6 Data Downlink

Not applicable to this device.

3.2.1.1.7 Mobility Mouse

A. Mobility Mouse shall have a total length of at least 2.5 meters.
B. Mobility Mouse shall function like a mouse with two buttons, one a right click and one a left click.
C. Mobility Mouse shall be operable via either hand.
D. Mobility Mouse shall be operable in zero-g.

3.2.1.1.8 Other Electrical Interfaces

A. Mobility shall provide at least one Universal Serial Bus (USB) port not designated for any function described in 3.2.1.1.
B. Mobility shall provide an external Red, Green, Blue (RGB) input connection.

3.2.1.1.9 Processors and Memory Requirements

A. The Mobility processor shall have a clock frequency of at least 1 GHz.
B. The Mobility processor shall have at least 512M DDRAM.
C. The Mobility video processor shall support at least 4x Accelerated Graphics Port (AGP).
D. The Mobility processor shall support R2WS and Mobility Integrated Drive Electronics (IDE) Drive types.
E. The Mobility IDE drive shall have at least 200 Gbytes of storage space.
F. The Mobility graphics card shall have at least 60 Meg of on-board video memory.

3.2.1.1.10 Boot Method

A. Mobility shall boot without the aid of an external keyboard or mouse.
B. Mobility shall boot into the Session Manager Window.

3.2.1.1.11 Software Navigation

A. Mobility shall allow the subject to navigate Mobility software menus in the Windows 2000 environment via the integrated touch screen.
B. Mobility shall navigate between the Session Manger and the Treadmill Training Manager.
C. Mobility shall navigate between the Session Manger and the Visual Acuity Manager.

3.2.1.1.12 Structural and Power Interfaces

A. Mobility structural and power interfaces to the vehicle will be defined in Section 3.2.7.5.

B. MGD shall provide a mechanical interface to MVAD.

C. Mobility Mounting Bracket (MMB) shall mate with the Treadmill Vibration Isolation System (TVIS) control panel and Mobility display.

D. MMB shall allow display position adjustments of:

1. +/- 8.8 cm along the axis parallel to the subject midline
2. +/- 4.4 cm along the axis laterally perpendicular to the subject midline

3.2.2 Physical Characteristics

3.2.2.1 Mass Properties

The mass of the Mobility hardware shall not exceed 200 lbf.

3.2.2.2 Envelope

3.2.2.2.1 Stowed Envelope

Dimensions of the stowed Mobility hardware shall not exceed that of a MO2 bag.

Stowage Unit	Internal Volume Allowance (1)	Reference
M02 Bag (4 CTBE)	7.92 ft^3 34.25 in (W) x 20.5 in (D) x 19.5 in (H)	SSP 50467 Sections 3.2.3 and 3.2.4.

3.2.2.2.2 Deployed Envelope

3.2.2.2.2.1 On-Orbit Payload Protrusions

Definitions, for on-orbit permanent protrusions, on-orbit semi-permanent protrusions, on-orbit temporary protrusions, on-orbit momentary protrusions, and protrusions for on-orbit keep-alive payloads can be found in Section 6.1 Definitions. The requirements in Section 3.2.2.2.2.1 apply to installation and operation activities, but not to maintenance activities. (LS-71000, Section 6.3.1.5)

NOTE: The on-orbit protrusion requirements in this section are applicable to when the payload is on-orbit and do not apply to other phases of the transportation of the payload (e.g., launch, landing, Mini Pressurized Logistics Module (MPLM), installation). (LS-71000, Section 6.3.1.5)

A. On-orbit protrusions, excluding momentary protrusions, shall not extend laterally across the edges of the rack or pass between racks. (LS-71000, Section 6.3.1.5.A)

B. EUE, excluding momentary protrusions, shall not prevent attachment of Reliability, Maintainability and Availability (RMA) of any seat track attach holes. (LS-71000, Section 6.3.1.5.B)

Constraints which, may be associated with payload protrusions include:

- Removal of the protrusion during rack installation, translation, and crew translation
- Removal of the protrusion if RMA is installed on the rack
- Removal of the protrusion to prevent interference with microgravity operations
- Removal or powering off of the rack if the protrusion blocks Portable Fire Extinguisher (PFE) access or the fire indicator
- May limit the rack location (e.g., Protrusion located in the floor and the ceiling are limited to a total of no more than 12 inches.)
- May limit operation of the payload

As is indicated by the constraints above, protrusions have a negative impact on crew operations and are to be minimized. (LS-71000, Section 6.3.1.5)

NOTE: Mobility plans to seek an exception for the above listed requirements.

3.2.2.2.2.1.1 On-Orbit Permanent Protrusions

Not applicable.

3.2.2.2.2.1.2 On-Orbit Semi-Permanent Protrusions

Not applicable.

3.2.2.2.2.1.3 On-Orbit Temporary Protrusions

A. On-orbit temporary protrusions shall remain within the envelope shown in Figure 3.2.2.2.2.1.3-1. (LS-71000, Section 6.3.1.5.3A)

B. The combination of all on-orbit temporary protrusions for the integrated rack shall be designed such that they can be eliminated or returned to their stowed configuration by the crew with hand operations and/or standard IVA tools within 10 minutes. (LS-71000, Section 6.3.1.5.3B)

NOTE: Integrated racks must provide stowage for on-orbit temporary protrusions with their stowage allocation. (LS-71000, Section 6.3.1.5.3)

NOTE: On-orbit temporary protrusions for payloads located in the floor or ceiling are limited to 6 inches beyond each or a total of 12 inches for both floor and ceiling. (LS-71000, Section 6.3.1.5.3)

NOTE: Mobility plans to seek an exception for the above listed requirements.

3.2.2.2.2.1.4 On-Orbit Momentary Protrusions

Not Applicable.

3.2.2.2.2.1.5 Deleted.

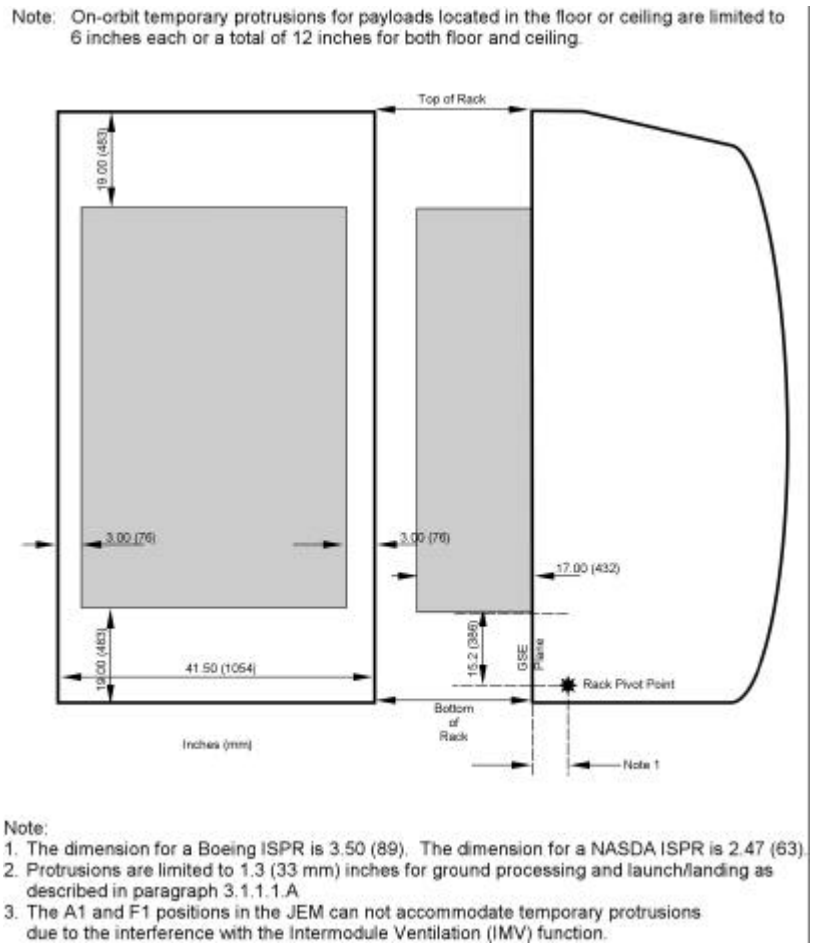


Figure 3.2.2.2.2.1.3-1. On-Orbit Temporary Protrusions Envelope

NOTE: All sections mentioned in the figure refer to the applicable section of SSP57000E.

3.2.2.2.2.2 Deployed Envelope Dimensions

Mobility deployed hardware should be measured and its dimensions documented on a TPS (JSC Form 1225). The tolerance of the measuring system should also be recorded on this form. As an alternative, the hardware provider may provide the item dimensions and the measuring system tolerance as part of the data package. Estimated deployed envelope dimensions should be provided as early in the design process as possible. (NOTE: This data is to be provided for flight integration purposes.)

3.2.3 Reliability, Quality and Non-Conformance Reporting

A. Not applicable.

B. Quality Assurance for the HRF Program shall be implemented in accordance with JPD 5335.1, "JSC Quality Manual." (LS-71000, Section 7.3.1)

C. Non-Conformance Reporting

1. For flight hardware produced under a contract or subcontract at a site other than JSC, non-conformance reporting requirements shall be specified in the (Statement of Work) Statement of Work (SOW) Data Requirements List (DRL) and Data Requirements Documents (DRDs) shall be used to identify the submittal and data requirements. (LS-71000, Section 7.3.2(1))
2. For flight hardware developed at JSC, non-conformance reporting shall be in accordance with JPD 5335.1 and the applicable technical division plan. (LS-71000, Section 7.3.2(2))
3. Non-conformances, which meet the Level 1 Problem Reporting and Corrective Action (PRACA) criteria for payloads as defined in SSP 30223, shall be reported in accordance with SSP 30223. (LS-71000, Section 7.3.2(3))
4. Software non-conformance reporting shall be in accordance with LS-71020-1, "Software Development Plan for the Human Research Facility." (LS-71000, Section 7.3.2(4))

3.2.3.1 Failure Propagation

The design shall preclude propagation of failures from the payload to the environment outside the payload. (NSTS 1700.7B, Section 206)

3.2.3.2 Useful Life

The Mobility hardware shall be designed for a 10-year utilization with ground refurbishment. (LS-71000, Section 7.2.1) This useful life can be obtained by replacing limited life items (e.g., batteries) with Orbital Replacement Units (ORUs) and/or allowing for ground refurbishment. (LS-71000, Section 7.2.1)

3.2.4 Maintainability

A. Not applicable.
B. Not applicable.
C. Not applicable.
D. Electrical connectors and cable installations shall permit disconnection and reconnection without damage to wiring connectors. (LS-71000, Section 6.4.4.3.2C)
E. Not applicable.
F. Not applicable.
G. The capture elements, including grids, screens, or filter surfaces shall be accessible for replacement or cleaning without dispersion of the trapped materials. (LS-71000, Section 6.4.3.1.2B)

3.2.4.1 Logistics and Maintenance

3.2.4.1.1 Payload In-Flight Maintenance

Not applicable.

3.2.4.1.2 Maintenance

The Mobility hardware in-flight cleanliness/maintenance will be controlled through an on-orbit operations procedure. No unscheduled on-orbit maintenance activities will be performed. The following scheduled maintenance activities will be performed:

Fan screen cleaning will be performed as necessary.

3.2.5 Environmental Conditions

3.2.5.1 On-Orbit Environmental Conditions

3.2.5.1.1 On-Orbit Internal Environments

3.2.5.1.1.1 Pressure

The Mobility hardware shall be safe when exposed to pressures of 0 to 104.8 kPa (0 to 15.2 psia). (LS-71000, Section 6.3.7.1.1)

3.2.5.1.1.2 Temperature

The Mobility hardware shall be safe when exposed to temperatures of 10° to 46 °C (50 to 115 °F). (LS-71000, Section 6.3.7.1.2)

3.2.5.1.1.3 Humidity

Not applicable.

3.2.5.1.2 Use of Cabin Atmosphere

3.2.5.1.2.1 Active Air Exchange

Not applicable.

3.2.5.1.2.2 Oxygen Consumption

Not applicable.

3.2.5.1.2.3 Chemical Releases

Chemical releases to the cabin air shall be in accordance with paragraphs 209.1a and 209.1b in NSTS 1700.7, ISS Addendum. (LS-71000, Section 6.3.7.2.3)

3.2.5.1.2.4 Cabin Air Heat Leak

Cabin air heat rejection is defined by the ISS program in terms of ISS modules only. No sub-allocation has been made for integrated racks or EUE. Mobility hardware maximum cabin air heat rejection must be documented in the Mobility hardware ICD. (LS-71000, Section 6.3.4.2)

3.2.5.1.3 Ionizing Radiation Requirements

3.2.5.1.3.1 Instrument Contained or Generated Ionizing Radiation

EUE containing or using radioactive materials or that generate ionizing radiation shall comply with NSTS 1700.7, ISS Addendum, paragraph 212.1. (LS-71000, Section 6.3.7.3.1)

3.2.5.1.3.2 Ionizing Radiation Dose

EUE should expect a total dose (including trapped protons and electrons) of 30 Rads (Si) per year of ionizing radiation. A review of the dose estimates in the ISS (SAIC-TN-9550) may show ionizing radiation exposure to be different than 30 Rads (Si) per year, if the intended location of the rack in the ISS is known. (LS-71000, Section 6.3.7.3.2)

NOTE: This is a testing guideline and is not a verifiable requirement.

3.2.5.1.3.3 Single Event Effect Ionizing Radiation

The Mobility hardware shall be designed not to produce an unsafe condition or one that could cause damage to equipment external to the Mobility hardware as a result of exposure to Single Event Effect (SEE) ionizing radiation assuming exposure levels specified in SSP 30512, paragraph 3.2.1, with a shielding thickness of 25.4 mm (1000 mils). (LS-71000, Section 6.3.7.3.3)

3.2.5.1.3.4 Lab Window Rack Location Radiation Requirements

Not applicable.

3.2.5.1.3.4.1 Window Rack Infrared Radiation Requirements

Not applicable.

3.2.5.1.3.4.2 Window Rack Ultraviolet Radiation Requirements

Not applicable.

3.2.5.1.4 Additional Environmental Conditions

The environmental information provided in Table 3.2.5.1.4-1, Environmental Conditions on ISS, and Figure 3.2.5.1.4-1, Operating Limits of the ISS Atmospheric Total Pressure, Nitrogen and Oxygen Partial Pressures, is for design and analysis purposes. (LS-71000, Section 6.3.7.3.5)

TABLE 3.2.5.1.4-1. ENVIRONMENTAL CONDITIONS

Environmental Conditions	Value	
Atmospheric Conditions on ISS		
Pressure Extremes	0 to 104.8 kPa (0 to 15.2 psia)	
Normal operating pressure	See Figure 3.2.5.1.4-1	
Oxygen partial pressure	See Figure 3.2.5.1.4-1	
Nitrogen partial pressure	See Figure 3.2.5.1.4-1	
Dewpoint	4.4 to 15.6 °C (40 to 60 °F)	
Percent relative humidity	25 to 75 %	
Carbon dioxide partial pressure during normal operations with 6 crewmembers plus animals	24-hr average exposure 5.3 mm Hg Peak exposure 7.6 mm Hg	
Carbon dioxide partial pressure during crew changeout with 11 crewmembers plus animals	24-hr average exposure 7.6 mm Hg Peak exposure 10 mm Hg	
Cabin air temperature in USL, JEM, APM and CAM	17 to 28 °C (63 to 82 °F)	
Cabin air temperature in Node 1	17 to 31 °C (63 to 87 °F)	
Air velocity (nominal)	0.051 to 0.203 m/s (10 to 40 ft/min)	
Airborne microbes	Less than 1000 CFU/m3	
Atmosphere particulate level	Average less than 100,000 particles/ft^3 for particles less than 0.5 microns in size	
MPLM Air Temperatures	**Passive Flights**	**Active Flights**
Pre-Launch	15 to 24 °C (59 to 75.2 °F)	14 to 30 °C (57.2 to 86 °F)
Launch/Ascent	14 to 24 °C (57.2 to 75.2 °F)	20 to 30 °C (68 to 86 °F)
On-Orbit (Cargo Bay + Deployment)	24 to 44 °C (75.2 to 111.2 °F)	16 to 46 °C (60.8 to 114.8 °F)
On-Orbit (On-Station)	23 to 45 °C (73.4 to 113 °F)	16 to 43 °C (60.8 to 109.4 °F)
On-Orbit (Retrieval + Cargo Bay)	17 to 44 °C (62.6 to 111.2 °F)	11 to 45 °C (51.8 to 113 °F)
Descent/Landing	13 to 43 °C (55.4 to 109.4 °F)	10 to 42 °C (50 to 107.6 °F)
Post-Landing	13 to 43 °C (55.4 to 109.4 °F)	10 to 42 °C (50 to 107.6 °F)
Ferry Flight	15.5 to 30 °C (59.9 to 86 °F)	15.5 to 30 °C (59.9 to 86 °F)
MPLM Maximum Dewpoint Temperatures		
Pre-Launch	13.8 °C (56.8 °F)	12.5 °C (54.5 °F)
Launch/Ascent	13.8 °C (56.8 °F)	12.5 °C (54.5 °F)
On-Orbit (Cargo Bay +Deployment)	13.8 °C (56.8 °F)	12.5 °C (54.5 °F)
On-Orbit (On Station)	15.5 °C (60 °F)	15.5 °C (60 °F)
On-Orbit (Retrieval + Cargo Bay)	10 °C (50 °F)	10 °C (50 °F)
Descent/Landing	10 °C (50 °F)	10 °C (50 °F)
Post Landing	10 °C (50 °F)	10 °C (50 °F)
Ferry Flight	15.5 °C (60 °F)	15.5 °C (60 °F)
Thermal Conditions		
USL module wall temperature	13 °C to 43 °C (55 °F to 109 °F)	
JEM module wall temperature	13 °C to 45 °C (55 °F to 113 °F) **(TBR)**	
APM module wall temperature	13 °C to 43 °C (55 °F to 109 °F) **(TBR)**	
CAM module wall temperature	13 °C to 43 °C (55 °F to 109 °F) **(TBR)**	
Other integrated payload racks	Front surface less than 37 °C (98.6 °F)	
***Microgravity**		
Quasi-Steady State Environment	See SSP 57000 Figures 3.9.4-2, 3.9.4-3 and Table 3.9.4-2	
Vibro-acoustic Environment	See SSP 57000 Figure 3.9.4-4	
General Illumination	108 Lux (10 fc) measured 30 inches from the floor in the center of the aisle	

*NOTE: Data reflects best available information as of May, 1997. Does not include effects of CAM.

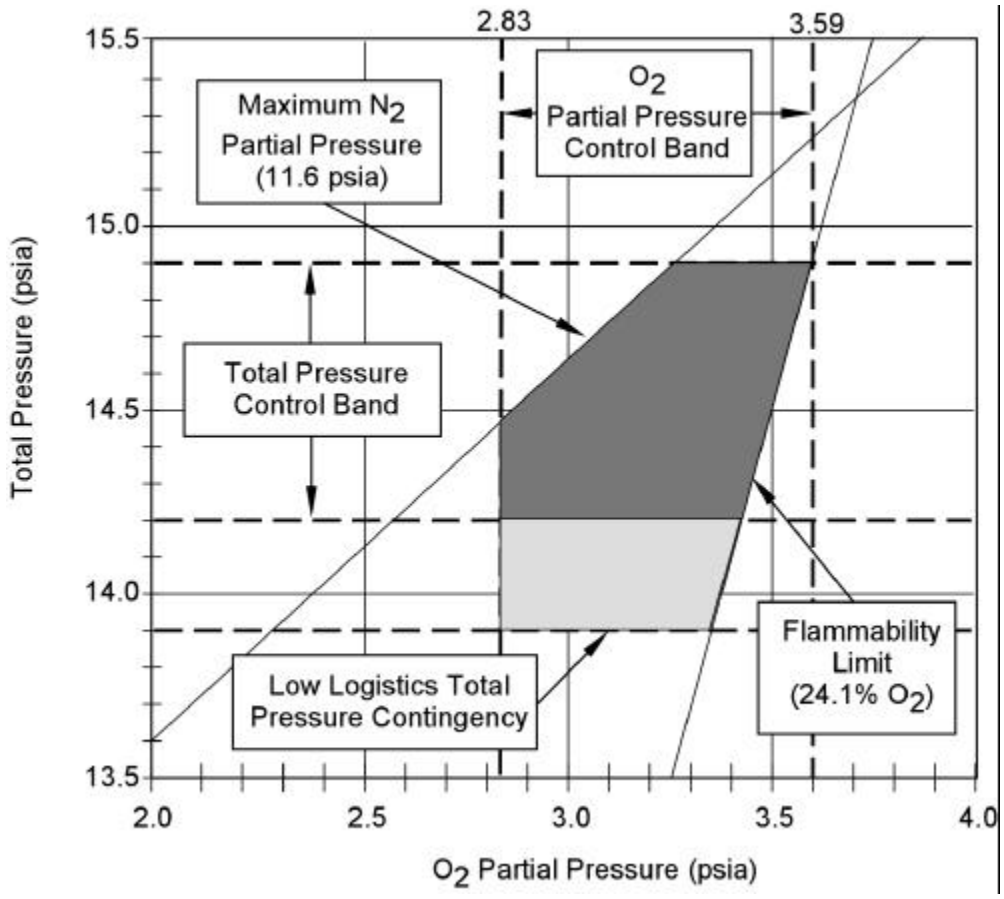


Figure 3.2.5.1.4-1. Operating Limits of the ISS Atmospheric Total Pressure, Nitrogen and Oxygen Partial Pressures

3.2.5.1.5 Pressure Rate of Change

A. The Mobility hardware shall maintain positive margins of safety for the on-orbit depress/repress rates in Table 3.2.5.1.5-1. (LS-71000, Section 6.3.1.2B)

TABLE 3.2.5.1.5-1. ISS PRESSURE RATE OF CHANGE

Depressurization	878 Pa/sec (7.64 psi/minute)
Repressurization	230 Pa/sec (2.0 psi/minute)

B. Deleted.

C. EUE shall maintain positive margins of safety for maximum depressurization and repressurization rates for the carrier(s) in which it will be transported. (LS-71000, Section 6.3.1.2A)

1. EUE shall maintain positive margins of safety for maximum depressurization and repressurization rates for the MPLM documented in Table 3.2.5.1.5-2. (Derived from LS-71000, Section 6.3.1.2A)

TABLE 3.2.5.1.5-2. MPLM PRESSURE RATE OF CHANGE

Depressurization	890 Pa/sec (7.75 psi/minute)
Repressurization	800 Pa/sec (6.96 psi/minute)

2. EUE shall maintain positive margins of safety for maximum depressurization and repressurization rates for the Orbiter Middeck documented in Table 3.2.5.1.5-3. (Derived from LS-71000, Section 6.3.1.2A)

TABLE 3.2.5.1.5-3. ORBITER MIDDECK PRESSURE RATE OF CHANGE

Depressurization/Repressurization	1031 Pa/sec (9.0 psi/minute)

D. Not applicable.

3.2.5.1.6 Microgravity

Microgravity requirements are defined to limit the disturbing effects of Integrated Racks and non-rack payloads on the microgravity environment of other payloads during microgravity mode periods. Non-rack payloads will be given a one quarter rack microgravity disturbance allocation. These requirements are separated into the quasi-steady category for frequencies below 0.01 Hz, the vibratory category for frequencies between 0.01 Hz and 300 Hz, and the transient category. For integrated racks, the interface points are the locations on the ISS structure where rack attachment brackets or isolation systems connect to the ISS. These requirements will apply to all NASA developed payloads and to any International Partners (IP) developed payloads that will be located in the USL.

3.2.5.1.6.1 Quasi-Steady Requirements

For frequencies below 0.01 Hz, Integrated racks and non-rack payloads shall limit unbalanced translational average impulse to generate less than 10 lb-s (44.8 N-s) within any 10 to 500 second period, along any ISS coordinate system vector.

3.2.5.1.6.2 Vibratory Requirements

Between 0.01 and 300 Hz, Integrated Rack payloads without ARIS and inactive ARIS racks shall limit vibration so that the limits of Figure 3.2.5.1.6.2-1 are not exceeded using the force method, or the limits of Table 3.2.5.1.6.2-2 are not exceeded using the acceleration method. Non-Rack payloads shall limit vibration so that one-fourth of the limits of Figure 3.2.5.1.6.2-1 are not exceeded using the force method, or one-fourth the limits of Table 3.2.5.1.6.2-2 are not exceeded using the acceleration method.

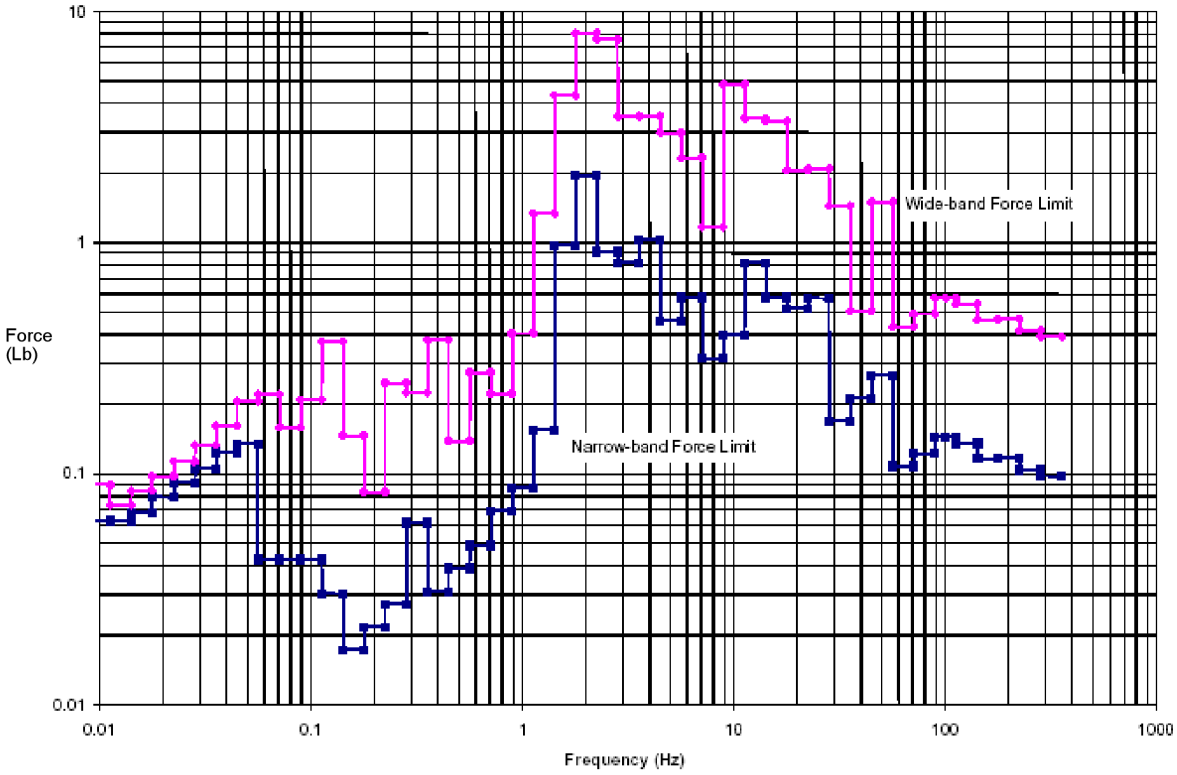


Figure 3.2.5.1.6.2-1. Allowable One-third Octave Interface Forces for Integrated racks and non-rack payloads, 0.5% damping factor

NOTE: on-Rack Payloads are limited to one-fourth of this allocation

TABLE 3.2.5.1.6.2-1. ALLOWABLE INTEGRATED RACK NARROW-BAND ENVELOPE AND WIDEBAND INTERFACE FORCE VALUES FOR ISPRS, 0.5% DAMPING FACTOR

Freq. (Hz)	NB lb f	WB Lb f	Freq. (Hz)	NB lb f	WB Lb f	Freq. (Hz)	NB lb f	WB Lb f
0.008913	0.06261	0.089635	0.3548	0.061482	0.224779	11.22	0.817148	3.451307
0.01122	0.06261	0.089635	0.3548	0.030924	0.378806	14.13	0.817148	3.451307
0.01122	0.06261	0.073218	0.4467	0.030924	0.378806	14.13	0.579786	3.358266
0.01413	0.06261	0.073218	0.4467	0.038934	0.138909	17.78	0.579786	3.358266
0.01413	0.068172	0.084667	0.5623	0.038934	0.138909	17.78	0.516921	2.048448
0.01778	0.068172	0.084667	0.5623	0.04901	0.274588	22.39	0.516921	2.048448
0.01778	0.079202	0.097495	0.7079	0.04901	0.274588	22.39	0.57451	2.091627
0.02239	0.079202	0.097495	0.7079	0.06922	0.222568	28.18	0.57451	2.091627
0.02239	0.091377	0.112968	0.8913	0.06922	0.222568	28.18	0.168996	1.443748
0.02818	0.091377	0.112968	0.8913	0.087153	0.404688	35.48	0.168996	1.443748
0.02818	0.105641	0.133067	1.122	0.087153	0.404688	35.48	0.212776	0.50643
0.03548	0.105641	0.133067	1.122	0.154561	1.337042	44.67	0.212776	0.50643
0.03548	0.123739	0.161094	1.413	0.154561	1.337042	44.67	0.267886	1.498072
0.04467	0.123739	0.161094	1.413	0.976353	4.322593	56.23	0.267886	1.498072
0.04467	0.134457	0.205508	1.778	0.976353	4.322593	56.231	0.10793	0.431721
0.05623	0.134457	0.205508	1.778	1.953413	8.01995	70.79	0.10793	0.431721
0.05623	0.042699	0.22137	2.239	1.953413	8.01995	70.791	0.122491	0.489965
0.07079	0.042699	0.22137	2.239	0.915835	7.567684	89.13	0.122491	0.489965
0.07079	0.042699	0.158917	2.818	0.915835	7.567684	89.131	0.143827	0.575309
0.08913	0.042699	0.158917	2.818	0.818034	3.504552	100	0.143827	0.575309
0.08913	0.042699	0.2093	3.548	0.818034	3.504552	112.2	0.143827	0.575309
0.1122	0.042699	0.2093	3.548	1.029953	3.531682	112.2	0.135367	0.541469
0.1122	0.030213	0.373089	4.467	1.029953	3.531682	141.3	0.135367	0.541469
0.1413	0.030213	0.373089	4.467	0.460611	2.979207	141.3	0.115819	0.463274
0.1413	0.017289	0.146008	5.623	0.460611	2.979207	177.8	0.115819	0.463274
0.1778	0.017289	0.146008	5.623	0.579824	2.330438	177.8	0.116941	0.467763
0.1778	0.021755	0.083429	7.079	0.579824	2.330438	223.9	0.116941	0.467763
0.2239	0.021755	0.083429	7.079	0.315606	1.16448	223.9	0.104363	0.417452
0.2239	0.027396	0.24715	8.913	0.315606	1.16448	281.8	0.104363	0.417452
0.2818	0.027396	0.24715	8.913	0.39737	4.848007	281.8	0.097688	0.390751
0.2818	0.061482	0.224779	11.22	0.39737	4.848007	354.8	0.097688	0.390751

NOTE: Non-Rack Payloads are limited to one-fourth of this allocation

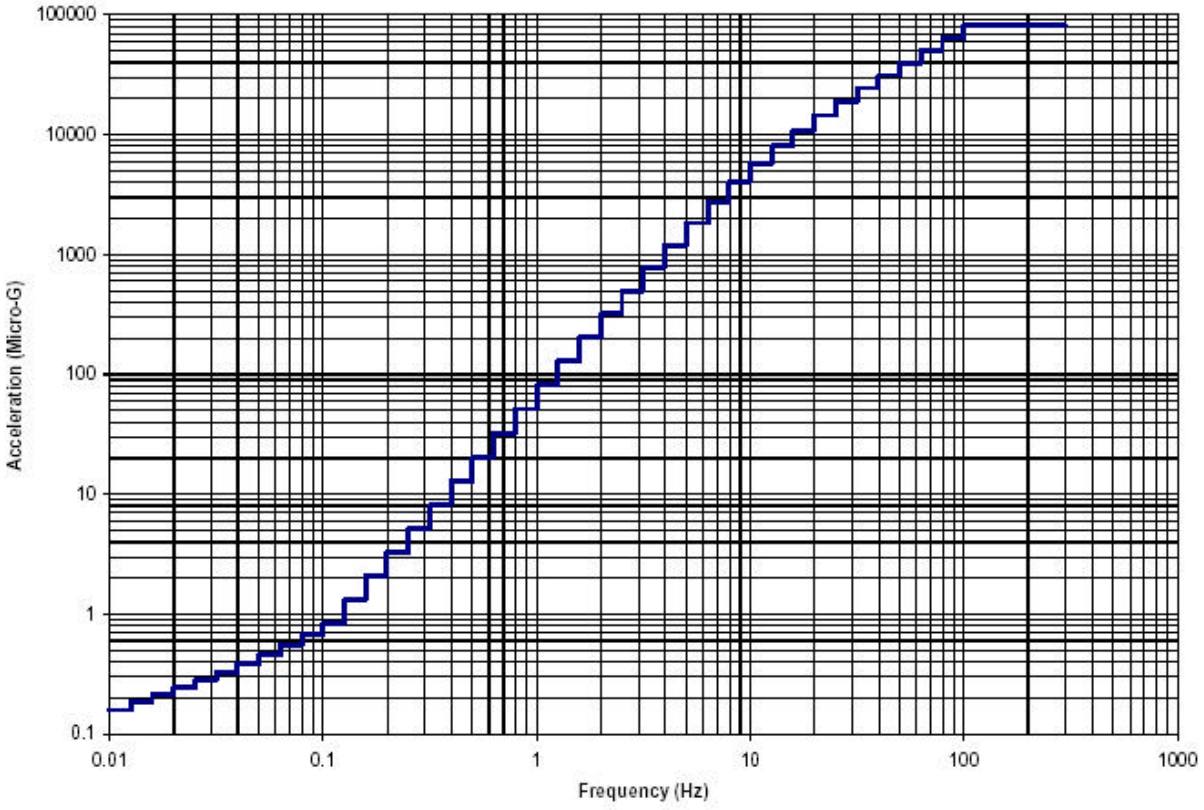


Figure 3.2.5.1.6.2-2. Non-ARIS to ARIS Acceleration Limit Alternative to Force Limits

NOTE: Non-rack payloads are limited to one-fourth of these values

TABLE 3.2.5.1.6.2-2. NON-ARIS INTEGRATED RACK TO ARIS ACCELERATION LIMIT ALTERNATIVE TO FORCE LIMITS

Freq.	Accel. Limit (ug)	Freq.	Accel. Limit (ug)	Freq.	Accel. Limit (ug)
0.0089	0.159	0.226	5.18	5.74	2746
0.0112	0.159	0.285	5.18	7.23	2746
0.0112	0.185	0.285	8.19	7.23	4026
0.0141	0.185	0.359	8.19	9.11	4026
0.0141	0.213	0.359	12.97	9.11	5758
0.0178	0.213	0.452	12.97	11.48	5758
0.0178	0.244	0.452	20.53	11.48	8021
0.0224	0.244	0.570	20.53	14.47	8021
0.0224	0.281	0.570	32.49	14.47	10898
0.0283	0.281	0.718	32.49	18.23	10898
0.0283	0.325	0.718	51.42	18.23	14495
0.0356	0.325	0.904	51.42	22.96	14495
0.0356	0.383	0.904	81.33	22.96	18956
0.0449	0.383	1.139	81.33	28.93	18956
0.0449	0.458	1.139	128.51	28.93	24483
0.0565	0.458	1.435	128.51	36.45	24483
0.0565	0.556	1.435	202.73	36.45	31346
0.0712	0.556	1.808	202.73	45.93	31346
0.0712	0.682	1.808	318.99	45.93	39894
0.0897	0.682	2.278	318.99	57.87	39894
0.0897	0.843	2.278	499.90	57.87	50578
0.1130	0.843	2.871	499.90	72.91	50578
0.1130	1.322	2.871	778.69	72.91	63958
0.1424	1.322	3.617	778.69	91.86	63958
0.1424	2.079	3.617	1202.18	91.86	80751
0.1794	2.079	4.557	1202.18	100.00	80751
0.1794	3.280	4.557	1832.55	300.00	80751
0.2260	3.280	5.741	1832.55		

NOTE: Non-rack payloads are limited to one-fourth of these values

PAYLOAD INTERFACE FORCE METHOD

The total force will be calculated as the RMS average of the forces at all interface points for inactive (latched) ARIS payload configurations, or the RSS of the forces at all interface points for non-ARIS payloads and Non-Rack payloads. The force at each interface point will be calculated to be the root-summed squared (RSS) in all axis, within each third octave band, during the worst case 100 second interval.

The forces within each 1/3-octave band will be classified as either wide-band or narrow-band. Forces will be classified as wide-band if the peak-to-average ratio is less than or equal to five, otherwise they will be classified as narrow-band. The peak to average ratio will be determined by dividing the peak power spectrum magnitude of the one-third octave band by the average magnitude within the band for the axis in which the peak occurs. The forces so classified will then be compared to the appropriate limit (wide or narrow band) in Figure 3.2.5.1.6.2 -1.

OR

ADJACENT ARIS PAYLOAD ACCELERATION METHOD

The modeled payload-induced acceleration at an immediately adjacent ARIS rack interface described by an ISS Program Office supplied model is to be used. The interfaces are to consist of the isolation plate, "Z" panel, and "light rails," at which the rms accelerations within any one-third octave band, over any 100 second period, are not to exceed the limits shown in Figure 3.2.5.1.6.2-2. Application of this technique requires that the payload developer use the ISS Program Office provided interface model in conjunction with payload FEM and/or SEA models to calculate the ARIS interface accelerations resulting from the worst case combination of payload disturbance sources.

3.2.5.1.6.3 Transient Requirements

A. Integrated racks shall limit force applied to the ISS over any ten second period to an impulse of no greater than 10 lb-s (44.5 N-s). Non-rack payloads shall limit force applied to the ISS over any ten second period to an impulse of no greater than 2.5 lb-s (11.1 N-s).

B. Integrated racks and non-rack payloads shall limit their peak force applied to the ISS to less than 1000 lb (4448 N) for any duration.

NOTE: Meeting the transient requirements of both A and B does not obviate the need to also meet the 100 second vibration requirement of Section 3.2.5.1.6.2 for vibration included in and following the transient disturbance.

3.2.5.2 Acoustic Emission Limits

3.2.5.2.1 Continuous Noise Limits

Mobility hardware continuous acoustical emissions shall individually comply with the acoustic requirements (NC-40 equivalent) in Table 3.2.5.2.1-1. (LS-71000, Section 6.4.3.3.1C)

TABLE 3.2.5.2.1-1. CONTINUOUS NOISE LIMITS

Rack Noise Limits Measured at 0.6 Meters Distance From the Test Article	
Frequency Band (Hz)	Integrated Rack Sound Pressure Level (SPL)
63	64
125	56
250	50
500	45
1000	41
2000	39
4000	38
8000	37

3.2.5.2.2 Intermittent Noise Limits

A. The Integrated rack (including any supporting adjunct active portable equipment operated outside the integrated rack that is within or interfacing with the crew habitable volume) Intermittent Noise Source (See Section 6.1, Definitions) shall not exceed the Total Rack A-weighted SPL Limits during the Maximum Rack Noise Duration as specified in Table 3.2.5.2.2-1 when the equipment is operating in the loudest expected configuration and mode of operation that can occur on orbit under any planned operations. (LS-71000, Section 6.4.3.3.2A)

NOTE: These acoustic requirements do not apply during failure or maintenance operations. (LS-71000, Section 6.4.3.3.2)

TABLE 3.2.5.2.2-1. INTERMITTENT NOISE LIMITS

Rack Noise Limits Measured At 0.6 Meters Distance From The Test Article	
Maximum Rack Noise Duration	Total Rack A - Weighted SPL (dBA)
8 Hours	49
7 Hours	50
6 Hours	51
5 Hours	52
4 Hours	54
3 Hours	57
2 Hours	60
1 Hour	65
30 Minutes	69
15 Minutes	72
5 Minutes	76
2 Minutes	78
1 Minute	79
Not Allowed	80

B. The Rack Noise Duration is the total time that the rack produces intermittent noise above the NC-40 limit during a 24 hour time period. This duration is the governing factor in determining the allowable Intermittent Noise Limits. Regardless of the number of separate sources and varying durations within a rack, this cumulative duration shall be used to determine the A-weighted SPL limit in column B. (LS-71000, Section 6.4.3.3.2B)

3.2.5.3 Deleted.

3.2.6 Transportability

3.2.6.1 Launch and Landing

The Mobility hardware shall be transportable to and from orbit. Equipment carried in the Shuttle mid-deck lockers shall be transportable in the Shuttle mid-deck locker to and from orbit, as specified in NSTS-21000-IDD-MDK. (LS-71000, Section 6.3.1.3)

3.2.7 Operational Interface Requirements

3.2.7.1 Mechanical Interface Requirements

3.2.7.1.1 Connector Physical Mate

Not applicable.

Mobility hardware will mechanically mate with the Russian element for support and power.

3.2.7.2 Electrical Interface Requirements

Mobility hardware will mate with the Russian element for power.

3.2.7.2.1 Electromagnetic Radiation

3.2.7.2.1.1 Electromagnetic Compatibility

Not applicable.

3.2.7.2.1.1.1 Electrical Grounding

The Mobility hardware connected to Interface B or Interface C shall meet all requirements specified in Section 3 of SSP 30240. (LS-71000, Section 6.3.2.4.1)

NOTE: HRF mandates that grounding isolation requirements which are applicable at the rack level are also applicable at the subrack and rack dependent hardware levels for quality assurance purposes.

3.2.7.2.1.1.2 Electrical Bonding

Electrical bonding of the Mobility hardware connected to Interface B or Interface C shall be in accordance with Class S SSP 30245 and NSTS 1700.7, ISS Addendum, Sections 213 and 220. (LS-71000, Section 6.3.2.4.2)

3.2.7.2.1.2 Electromagnetic Interference

A. Not applicable.
B. Not applicable.

3.2.7.2.2 Electrostatic Discharge

A. Unpowered Mobility hardware EPCE shall not be damaged by Electrostatic Discharge (ESD) equal to or less than 4000 V to the case or any pin on external connectors. (LS-71000, Section 6.3.2.5)

B. Mobility hardware EPCE that may be damaged by ESD between 4000 V and 15,000 V shall have a label affixed to the case in a location clearly visible in the installed position. (LS-71000, Section 6.3.2.5)

C. Labeling of Mobility hardware EPCE susceptible to ESD up to 15,000 V shall be in accordance with MIL-STD-1686. (LS-71000, Section 6.3.2.5)

NOTE: These voltages are the result of charges that may be accumulated and discharged from ground personnel or crewmembers during equipment installation or removal. (LS-71000, Section 6.3.2.5)

3.2.7.2.3 Corona

The Mobility hardware shall be designed to preclude damaging or destructive corona in its operating environment. Guidance for meeting the corona requirement is found in MSFC-STD-531, High Voltage Design Criteria. (LS-71000, Section 6.3.2.8)

3.2.7.2.4 Cable/Wire Design and Control Requirements

Cabling between rack independent instruments and Interface B or Interface C shall meet all Cable and Wire requirements of SSP 30242. (LS-71000, Section 6.3.2.4.3)

3.2.7.2.4.1 Wire Derating

A. Deleted.

B. Derating criteria for rack independent instrument circuit elements below the first level of instrument provided circuit protection shall be per NASA Technical Memo (TM) 102179 as interpreted by NSTS 18798, TA-92-038. (LS-71000, Section 6.3.2.1B)

3.2.7.2.4.2 Exclusive Power Feeds

Not applicable.

3.2.7.2.5 Loss of Power

The Mobility hardware shall fail safe in the event of a total or partial loss of power, regardless of the availability of Auxiliary power in accordance with NSTS 1700.7, ISS Addendum. (LS-71000, Section 6.3.2.3)

3.2.7.2.6 Alternating Current Magnetic Fields

The generated Alternating Current (AC) magnetic fields, measured at a distance of seven centimeters (cm) from the generating equipment, shall not exceed 140 dB above one (1) picotesla for a frequency at 30 Hz, then falling 26.5 dB per decade to 3.5 kHz, and 85 dB for frequencies ranging from 3.5 kHz to 50 kHz. (LS-71000, Section 6.3.2.6)

3.2.7.2.7 Direct Current Magnetic Fields

The generated Direct Current (DC) magnetic fields shall not exceed 170 dB picotesla at a distance of seven cm from the generating equipment. This applies to electromagnetic and permanent magnetic devices. (LS-71000, Section 6.3.2.7)

3.2.7.2.8 UOP Interface Requirements

Not applicable.

3.2.7.3 Command and Data Handling Interface Requirements

The following requirements are defined for HRF Flight Software.

3.2.7.3.1 Reserved

3.2.7.3.2 HRF Software Requirements

Mobility does not download or downlink data.

3.2.7.3.3 Reserved

3.2.7.3.4 Reserved

3.2.7.4 Fire Protection Interface Requirements

Fire detection requirements for instruments operated outside of rack volumes have not been defined by ISS. Fire detection methodology for instruments operated outside of rack volumes must be approved by the Payload Safety Review Panel (PSRP). Fire protection requirements in this section apply to all instruments. Fire suppression requirements in this section apply for instruments operated outside of the rack volume that have forced airflow. (LS-71000, Section 6.3.8)

3.2.7.4.1 Fire Prevention

The Mobility hardware shall meet the fire prevention requirements specified in NSTS 1700.7B, ISS Addendum, paragraph 220.10a. (LS-71000, Section 6.3.8.1)

3.2.7.4.2 Fire Suppression

NOTE: Each separate HRF rack and subrack equipment volume, which contains a potential fire source will require fire suppression capabilities. Determination of potential fire sources will be presented to and approved

by the PSRP during the phased safety reviews. Safety fire suppression requirements are specified in NSTS 1700.7B, ISS Addendum, paragraph 220.10c (SSP 57000E, paragraph 3.10.3)

Not applicable.

3.2.7.4.3 Labeling

Not applicable.

3.2.7.5 Other Interface Requirements

3.2.7.5.1 Russian Segment Low Frequency Conducted Emissions

A. Effective values of the voltage of low frequency interference shall not exceed the limits in Figure 3.2.7.5.1-1

B. The peak voltage of low frequency interference in 28 V supply circuits shall not exceed 0.7V.

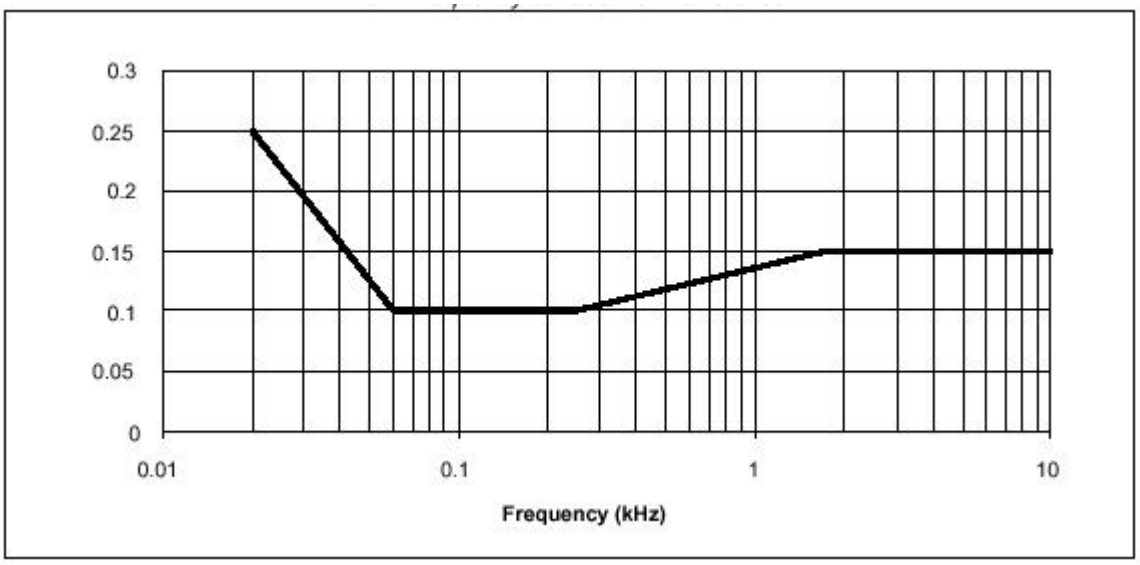


Figure 3.2.7.5.1-1. Russian Segment Effective Values of the Voltage of Low Frequency Interference

3.2.7.5.2 Russian Segment Radio Frequency Conducted Emissions

Quasi-peak values of radio frequency interference voltage shall not exceed the limits in Figure 3.2.7.5.2-1

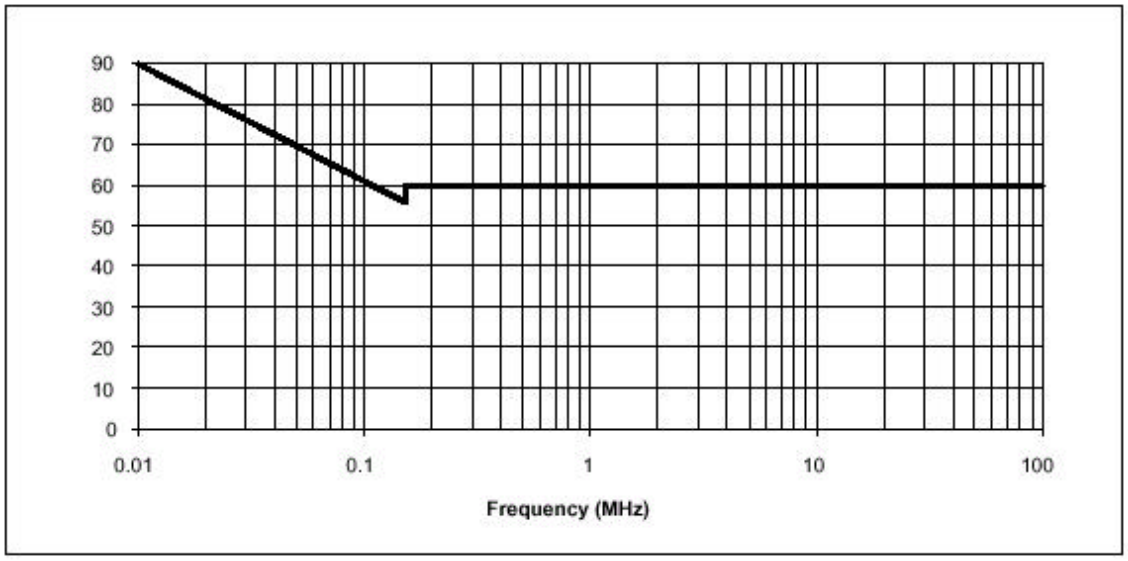


Figure 3.2.7.5.2-1. Russian Segment Quasi-peak Values of Radio Frequency Interference Voltage

3.2.7.5.3 Russian Segment Radio Frequency Radiated Emissions

Equipment installed in the Russian segment shall not produce interferences in excess of the limits in Figure 3.2.7.5.3-1.

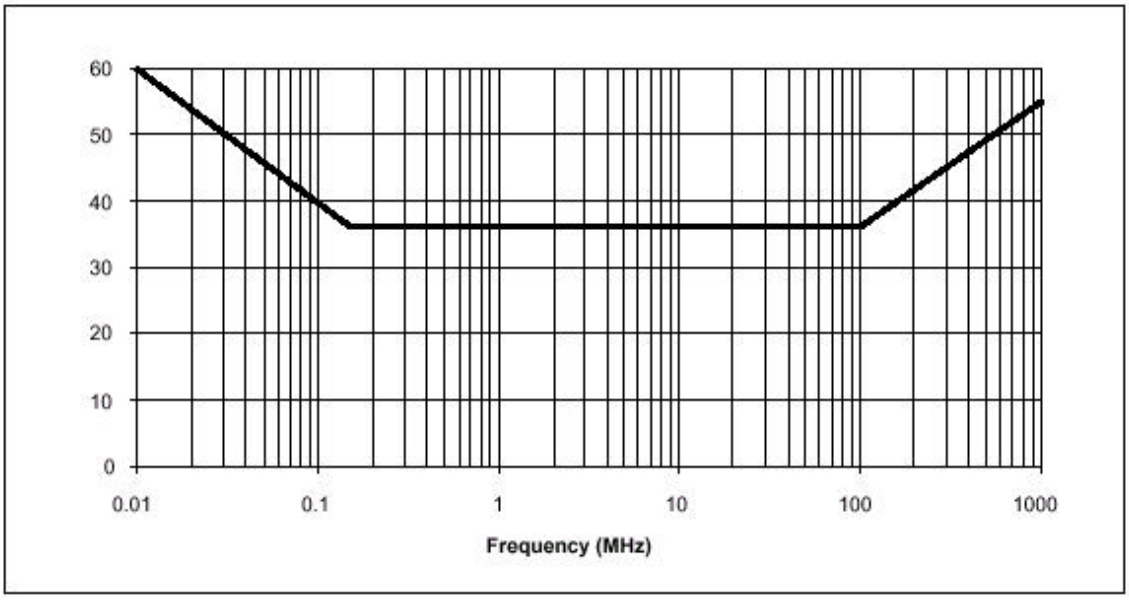


Figure 3.2.7.5.3-1. Russian Segment Radio Frequency Radiated Emissions

3.2.7.5.4 Russian Segment Low Frequency Conducted Susceptibility

Mobility hardware shall operate nominally during exposure to the conducted susceptibility environment in Figure 3.2.7.5.4-1.

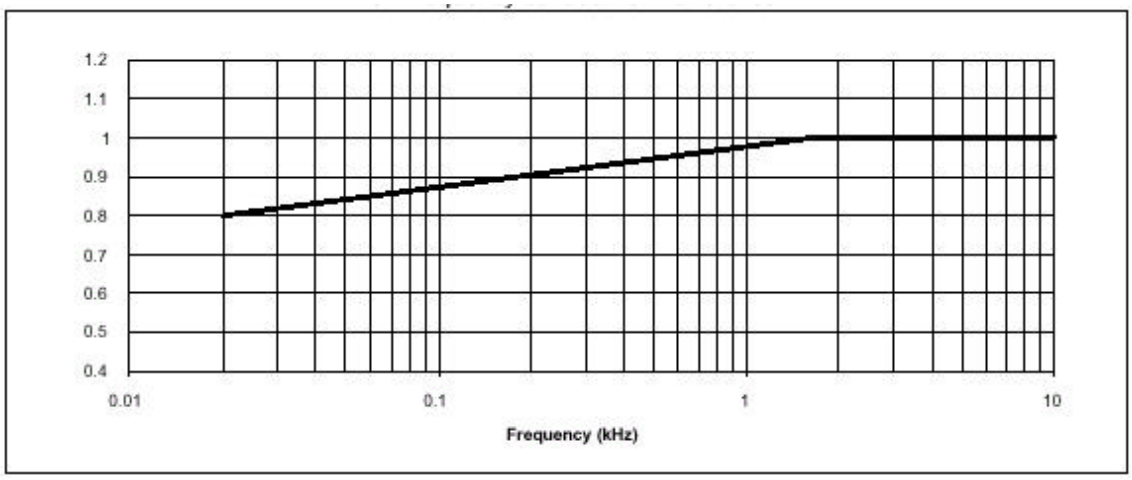


Figure 3.2.7.5.4-1. Russian Segment Low Frequency Conducted Susceptibility

3.2.7.5.5 Russian Segment Radio Frequency Conducted Susceptibility

Mobility hardware shall operate nominally during exposure to the conducted susceptibility environment in Figure 3.2.7.5.5-1.

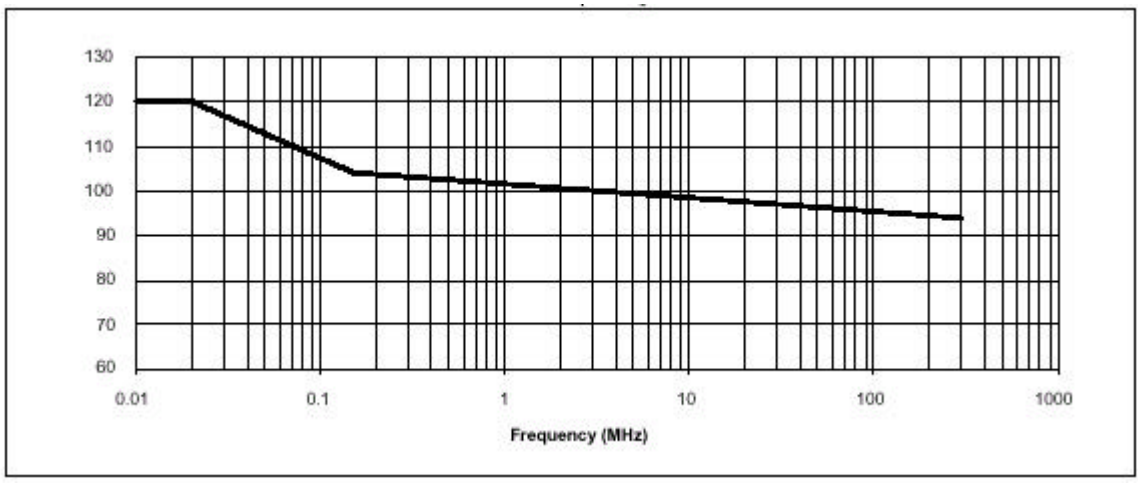


Figure 3.2.7.5.5-1. Russian Segment Radio Frequency Conducted Susceptibility

3.2.7.5.6 Russian Segment Pulse Conducted Susceptibility

Mobility hardware shall operate nominally during exposure to the following environments:

A. Steady state voltage between 25.0 and 29.0 volts.

B. The voltage amplitude of single positive and negative pulses between +28V power buses outside and inside a module is equal to 10V with a duration of 100+5 microseconds, with the leading edge lasting no more than 5 microseconds; internal resistance of the interference source is equal to 1 ohm (the amplitude of the test pulse should be set under no-load conditions)

C. The voltage amplitude of single positive and negative pulses between each of the +28V power buses and the chassis outside and inside a module is 35V, with a duration of 100+5 microseconds, with the leading edge lasting no more than 5 microseconds; internal resistance of the interference source is equal to 500 ohms (the amplitude of the test pulse should be set under no-load conditions)

D. The amplitude of a change in voltage (surges and dips) between +28V power buses when the load is switched (connected, disconnected) and the load current is greater than 100A, is +/- 1.5V, with a duration of up to 30 ms and a leading edge transition time of not less than 0.1 milliseconds.

3.2.7.5.7 Russian Segment Magnetic Susceptibility

Mobility hardware shall operate nominally during exposure to the magnetic field susceptibility environment in Figure 3.2.7.5.7-1.

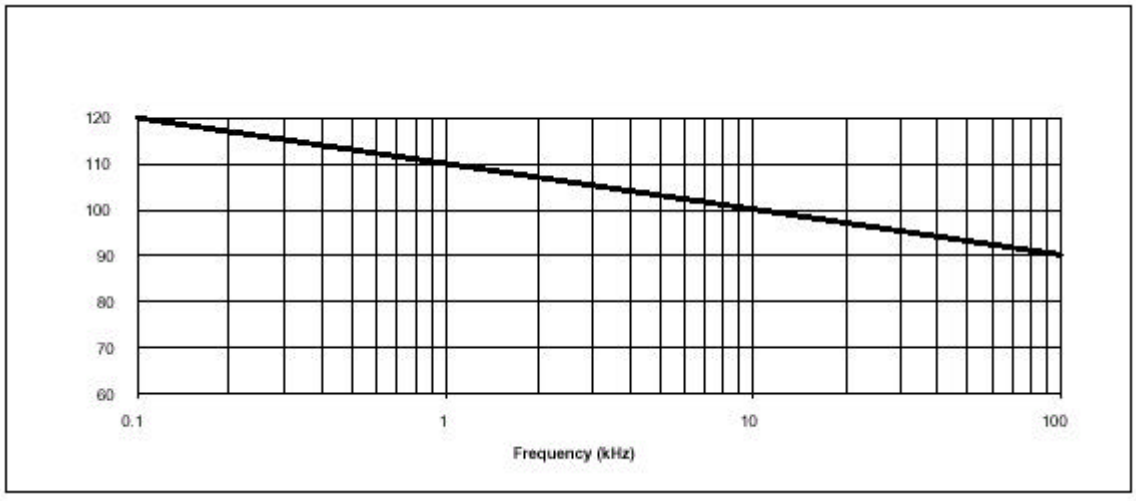


Figure 3.2.7.5.7-1. Russian Segment Magnetic Susceptibility

3.2.7.5.8 Russian Segment Radiated Susceptibility

Mobility hardware shall operate nominally during exposure to the radiated susceptibility environment in Figure 3.2.7.5.8-1.

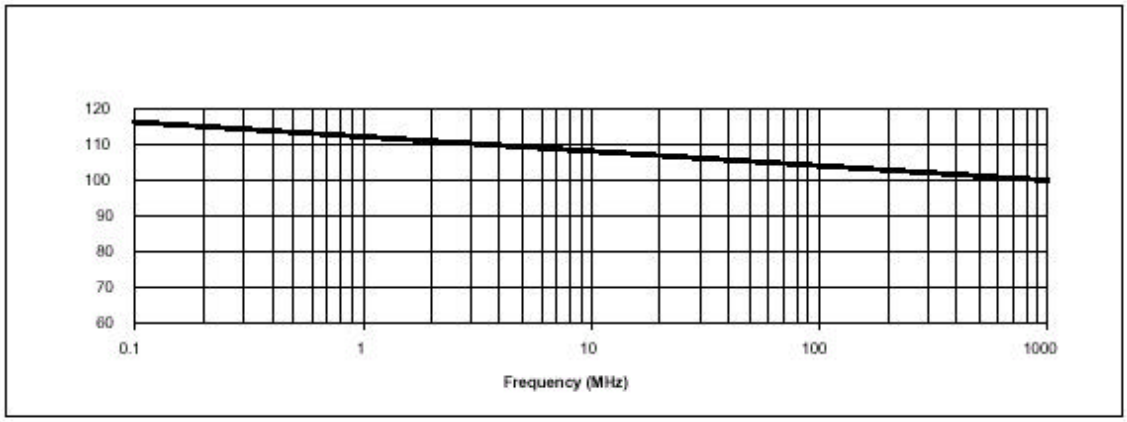


Figure 3.2.7.5.8-1. Russian Segment Radiated Susceptibility

3.2.7.5.9 Cable Voltage Drop

Power cabling shall have a voltage drop of less than 2.0 volts.

3.2.7.5.10 Surge Current

Starting currents must not exceed five times the steady-state operating current.

3.2.7.5.11 Electrical Insulation Resistance

The resistance of the insulation between the body of any equipment and the primary power circuits (both positive, negative, and ground leads) shall be no less than 1 Meg-Ohm with an atmospheric relative humidity of 95% +/- 3% at an air temperature of 20 ^{o}C +/- 5 ^{o}C.

3.2.7.5.12 Exclusion of Electrical Insulation Rupture

The resistance of the insulation between the body of any equipment and the primary power circuits (both positive and negative leads), and also between any electrically separated circuits shall meet 3.2.7.5.11 following the effect of a +/- 100 VDC test voltage on all these circuits.

3.2.7.5.13 Stability

Duration of current pulses resulting from positive and negative voltage changes at the equipment voltage input between 23.0 and 29.0 VDC shall not exceed 20 milliseconds within 10% of steady state current for the final voltage. (Pulse of transient needs to be identified as well)

3.2.7.5.14 Lighting Design

P/L work surface specularity shall not exceed 20 percent.

3.2.7.5.15 Lightning

The integrated rack and EPCE shall meet the lightning induced environment requirement in paragraph 3.2.8.1 of SSP 30243.

3.2.7.5.16 Color

Payloads shall select interior colors in accordance with the requirements in Table 3.2.7.5.16-1.

TABLE 3.2.7.5.16-1. SURFACE INTERIOR COLORS AND PAINTS

Hardware Description	Color	Finish	Paint Specification Per FED-STD-595
Equipment Rack Utility Panel Recess	White	Semigloss	27925
Equipment Rack Utility Panel Text Characters	Black	Lusterless	37038
ISPR Utility Panel Recess	White	Semigloss	27925
ISPR Utility Panel Recess Text Characters	Black	Lusterless	37038
Functional Unit Utility Panel Recess (as applicable)	White	Semigloss	27925
Functional Unit Utility Panel Recess Text Characters	Black	Lusterless	37038
Rack Front Aisle Extensions	Off-white	Semigloss	27722
Overhead Rack Face Plates	Off-white	Semigloss	27722
Port Rack Face Plates	Off-white	Semigloss	27722
Starboard Rack Face Plates	Off-white	Semigloss	27722
Deck Rack Face Plates	Off-white	Semigloss	27722
Overhead Rack Utility Panel Closeouts	Off-white	Semigloss	27722
Port Rack Utility Panel Closeouts	Off-white	Semigloss	27722
Starboard Rack Utility Panel Closeouts	Off-white	Semigloss	27722
Deck Rack Utility Panel Closeouts	Off-white	Semigloss	27722
Stowage Trays	Off-white	Semigloss	27722
Stowage Tray Handle Straps (any location)	Blue material	Semigloss	25102 or equiv.
Common Seat Track Interface	Clear (Anodized)	Semigloss	none
Glovebox (Aluminum or Plastic)	Medium Gray	Gloss	16329 or 16373
Glovebox (Aluminum)	White	Gloss	17925
Glovebox (Aluminum or Plastic)	Off-White	Gloss	17722
Glovebox (Aluminum)	Tan	Gloss	10475
EXPRESS Program Rack Utility Panels	Off-White	Gloss	17875

3.3 DESIGN AND CONSTRUCTION

3.3.1 Materials, Processes and Parts

3.3.1.1 Materials and Processes

A. The Mobility hardware shall use materials and parts that meet the materials requirements specified in NSTS 1700.7, ISS Addendum, Section 209. (LS-71000, Section 6.3.9.1)

B. COTS parts used in the Mobility hardware shall meet the materials requirements specified in NSTS 1700.7, ISS Addendum, Section 209. (LS-71000, Section 6.3.9.2)

C. The Mobility hardware shall conform to Visibly Clean-Sensitive (VC-S) requirements as specified in SN-C-0005. (LS-71000, Section 6.3.9.3)

D. Deleted.

E. HRF EUE instruments that are intended to remain on-orbit for more than one year shall use fungus resistant materials according to the requirements specified in SSP 30233, paragraph 4.2.10. (LS-71000, Section 6.3.9.4)

F. Materials shall comply with the "Agreement on the Safe Utilization of Materials in Cargos to be delivered to ISS by Any Vehicle and Transferred to ISS for Stowage and/or Operation" – 6/22/2000. (LS-71000, Section 6.3.9.1.1)

G. Fiberglass cloth tape shall not be used in HRF payloads that may be carried into the ISS Russian segment. (Materials and Processes Technology Branch)

3.3.1.2 Sharp Edges and Corner Protection

The Mobility hardware design within a pressurized module shall protect crewmembers from sharp edges and corners during all crew operations in accordance with NSTS 1700.7, ISS Addendum, paragraph 222.1. (LS-71000, Section 6.4.9.2)

3.3.1.3 Holes

Holes that are round or slotted in the range of 10.0 to 25.0 mm (0.4 to 1.0 in) shall be covered. (LS-71000, Section 6.4.9.3)

3.3.1.4 Latches

Latches that pivot, retract, or flex so that a gap of less than 35 mm (1.4 in) exists shall be designed to prevent entrapment of a crewmember's appendage. (LS-71000, Section 6.4.9.4)

3.3.1.5 Screws and Bolts

Threaded ends of screws and bolts accessible by the crew and extending more than 3.0 mm (0.12 in) shall be capped to protect against sharp threads. (LS-71000, Section 6.4.9.5)

3.3.1.6 Securing Pins

Securing pins shall be designed to prevent their inadvertently backing out above the handhold surface. (LS-71000, Section 6.4.9.6)

3.3.1.7 Levers, Cranks, Hooks and Controls

Levers, cranks, hooks, and controls shall not be located where they can pinch, snag, or cut the crewmembers or their clothing. (LS-71000, Section 6.4.9.7)

3.3.1.8 Burrs

Exposed surfaces shall be free of burrs. (LS-71000, Section 6.4.9.8)

3.3.1.9 Locking Wires

A. Safety wires shall not be used on fasteners, which must be unfastened for on-orbit removal or replacement. (LS-71000, Section 6.4.9.9A)

B. All fracture-critical fasteners as defined in SSP 52005 (paragraph 5.6, Fastener Requirements, and Appendix B, Glossary of Terms), which must be unfastened for on-orbit removal or replacement, shall be safety cabled or cotter pinned. (LS-71000, Section 6.4.9.9B)

C. Safety wire shall not be used on any on-orbit fastener. (Payload Safety Review Panel)

3.3.2 Nameplates and Product Marking

3.3.2.1 Equipment Identification

Integrated racks, all (installed in the rack or separately) sub-rack elements, loose equipment, stowage trays, consumables, ORUs, crew accessible connectors and cables, switches, indicators, and controls shall be labeled. Labels are markings of any form [including Inventory Management System (IMS) bar codes] such as decals and placards, which can be adhered, “silk screened,” engraved, or otherwise applied directly onto the hardware. Appendix C of SSP 57000E provides instructions for label and decal design and approval. (LS-71000, Section 6.4.7)

3.3.3 Workmanship

Workmanship shall be in accordance with approved NASA and industry recognized standards. (LS-71000, Section 7.3.1)

3.3.4 Interchangeability

Interchangeability requirements are not applicable to detail parts of permanent assemblies such as welded assemblies or matched detailed parts such as lapped components. Interchangeability requirements do not apply to custom-fitted or custom sized items.

All replaceable parts for the Mobility hardware having the same part number shall be directly and completely interchangeable with each other, with respect to form, fit and function.

3.3.5 Safety Requirements

3.3.5.1 Electrical Safety

3.3.5.1.1 Mating/Demating of Powered Connectors

A. The Mobility hardware shall comply with the requirements for mating/demating of powered connectors specified in NSTS 18798, MA2-97-093. (LS-71000, Section 6.3.2.10.1)

B. The Mobility hardware shall comply with the requirements for mating/demating of powered connectors specified in NSTS 18798, MA2-99-170.

3.3.5.1.2 Power Switches/Controls

A. Switches/controls performing on/off power functions for all Mobility hardware power interfaces shall open (dead-face) all supply circuit conductors except the power return and the equipment grounding conductor while in the power-off position. (LS-71000, Section 6.3.2.10.3A)

B. Power-off markings and/or indications shall be used only if all parts, with the exception of overcurrent devices and associated EMI filters, are disconnected from the supply circuit. (LS-71000, Section 6.3.2.10.3B)

C. Standby, charging, or other descriptive nomenclature shall be used to indicate that the supply circuit is not completely disconnected for this power condition. (LS-71000, Section 6.3.2.10.3C)

3.3.5.1.3 Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage

Not applicable.

3.3.5.1.4 Portable Equipment/Power Cords

A. Non-battery powered portable equipment shall incorporate a three-wire power cord. A three-wire power cord consists of a (+) supply lead, a (-) return lead and a safety (green) wire; one end of the safety (green) wire connected to the portable equipment chassis (and all exposed conductive surfaces) and the other end is connected to structure of the utility outlet (Payload provided outlet, UOP, etc.) or through the GFCI interface if GFCI is used. A system of double insulation or its equivalent, when approved by NASA, may be used without a ground wire. (LS-71000, Section 6.3.2.10.5A)

B. Not applicable.

3.3.6 Human Engineering

3.3.6.1 Closures or Covers Design Requirements

Closures or covers shall be provided for any area of the payload that is not designed for routine cleaning. (LS-71000, Section 6.4.3.1.1)

3.3.6.2 Interior Color

3.3.6.2.1 Rack Mounted Equipment

Not Applicable.

3.3.6.2.2 Stowed/Deployable Equipment

The colors and finishes for stowed and deployable equipment, even if it is normally attached to the rack during use shall be as specified below:

A. COTS equipment that is not repackaged by HRF engineers shall be finished as delivered by the manufacturer. (LS-71000, Section 6.4.3.5.2A)

B. Items that are repackaged by HRF engineers shall be finished using anodic film per MIL-A-8625, Type II, Class 2, Dyed Turquoise. Reference FED-STD-595, Color Specification 15187. (LS-71000, Section 6.4.3.5.2B)

3.3.6.2.3 Colors for Soft Goods

NOTE: Human factors engineering will provide guidance in the appropriate colors for soft goods, in cooperation with the lead engineers, who will provide data on the available color choices for the specified materials. (LS-71000, Section 6.4.3.5.3)

3.3.6.3 Full Size Range Accommodation

A. All payload workstations and hardware having crew nominal operations and planned maintenance shall be sized to meet the functional reach limits for the 5th percentile Japanese female and yet shall not constrict or confine the body envelope for the 95th percentile American male as specified in SSP 50005, Section 3. (LS-71000, Section 6.4.2.3)

B. COTS equipment shall be as delivered by the manufacturer and is exempted from this requirement.

3.3.6.4 Operation and Control of Payload Equipment

A. Grip Strength

To remove, replace, and operate payload hardware, grip strength required shall be less than 254 N (57 lbf). (LS-71000, Section 6.4.1.1A)

B. Linear Forces

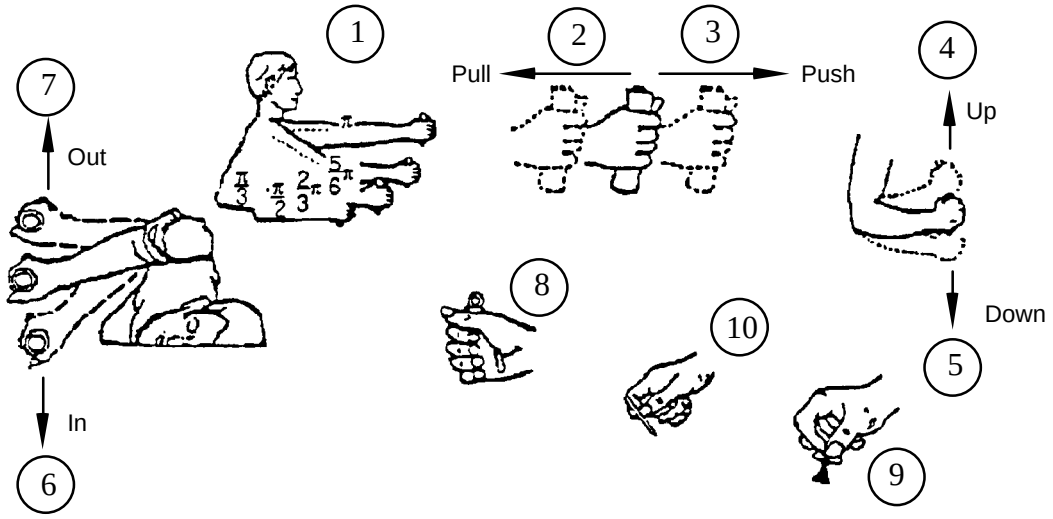
Linear forces required to operate or control payload hardware or equipment shall be less than the strength values for the 5th percentile female, defined as 50% of the strength values shown in Figure 3.3.6.4-1 and 60% of the strength values shown in Figure 3.3.6.4-2. (LS-71000, Section 6.4.1.1B)

C. Torque

Torque required to operate or control payload hardware or equipment shall be less than the strength values for the 5th percentile female, defined as 60% of the calculated 5th percentile male capability shown in Figure 3.3.6.4-3. (LS-71000, Section 6.4.1.1C)

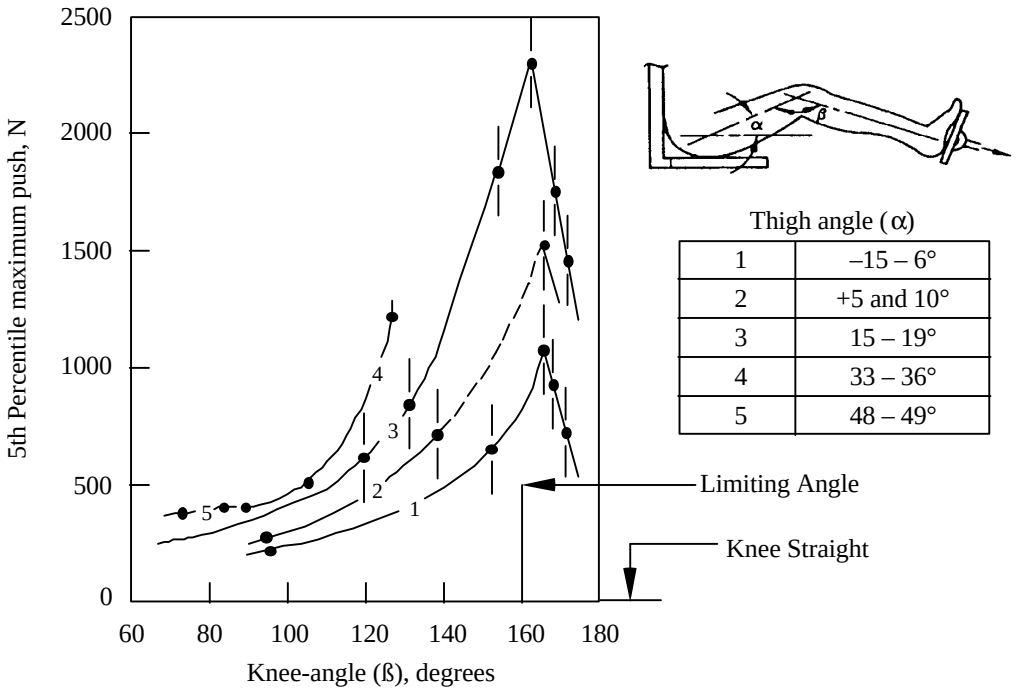
3.3.6.5 Maintenance Operations

Not applicable.



Arm Strength (N)												
(1)	(2)		(3)		(4)		(5)		(6)		(7)	
Degree of elbow flexion (rad)	Pull		Push		Up		Down		In		Out	
	L**	R**	L	R	L	R	L	R	L	R	L	R
p	222	231	187	222	40	62	58	76	58	89	36	62
5/6 p	187	249	133	187	67	80	80	89	67	89	36	67
2/3 p	151	187	116	160	76	107	93	116	89	98	45	67
1/2 p	142	165	98	160	76	89	93	116	71	80	45	71
1/3 p	116	107	96	151	67	89	80	89	76	89	53	76
Hand and thumb-finger strength (N)												
	(8)				(9)				(10)			
	Hand Grip											
	L		R		Thumb-finger grip (Palmer)				Thumb-finger grip (tips)			
Momentary hold	250		260		60				60			
Sustained hold	145		155		35				35			
*Elbow angle shown in radians **L = Left, R = Right												
Arm strength (lb)												
(1)	(2)		(3)		(4)		(5)		(6)		(7)	
Degree of elbow flexion (deg)	Pull		Push		Up		Down		In		Out	
	L	R*	L	R	L	R	L	R	L	R	L	R
180	50	52	42	50	9	14	13	17	13	20	8	14
150	42	56	30	42	15	18	18	20	15	20	8	15
120	34	42	26	36	17	24	21	26	20	22	10	15
90	32	37	22	36	17	20	21	26	16	18	10	16
60	26	24	22	34	15	20	18	20	17	20	12	17
Hand and thumb-finger strength (lb)												
	(8)				(9)				(10)			
	Hand Grip											
	L		R		Thumb-finger grip (Palmer)				Thumb-finger grip (tips)			
Momentary hold	56		59		13				13			
Sustained hold	33		35		8				8			
*Left; R = Right												

Figure 3.3.6.4-1. Arm, Hand and Thumb/Finger Strength (5th Percentile Male Data)



Thigh angle (α)

1	–15 – 6°
2	+5 and 10°
3	15 – 19°
4	33 – 36°
5	48 – 49°

Figure 3.3.6.4-2. Leg Strength at Various Knee and Thigh Angles (5th Percentile Male Data)

	Unpressurized suit, bare handed	
	Mean	SD
Maximum torque: Suppination, Nm (lb-in.)	13.73 (121.5)	3.41 (30.1)
Maximum torque: Pronation, Nm (lb-in.)	17.39 (153.9)	5.08 (45.0)

Figure 3.3.6.4-3. Torque Strength

3.3.6.6 Adequate Clearance

Not applicable.

3.3.6.7 Accessibility

A. Payload hardware shall be geometrically arranged to provide physical and visual access for all payload installation, operations, and maintenance tasks. Payload ORUs should be removable along a straight path until they have cleared the surrounding structure. (LS-71000, Section 6.4.2.2A)

B. Intravehicular Activity clearances for finger access shall be provided as given in Figure 3.3.6.7-1. (LS-71000, Section 6.4.2.2B)

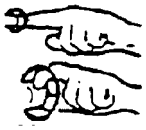
Minimal finger-access to first joint			
Push button access:	Bare hand: Thermal gloved hand:	32 mm dia. (1.26 in.) 38 mm dia. (1.5 in.)	
Two finger twist access:	Bare hand: Thermal gloved hand:	object plus 50 mm (1.97 in.) object plus 65 mm (2.56 in.)	

Figure 3.3.6.7-1. Minimum Sizes for Access Openings for Fingers

3.3.6.8 One-Handed Operation

Not applicable.

3.3.6.9 Continuous/Incidental Contact - High Temperature

When payload surfaces whose temperature exceeds 49 °C (120 °F), which are subject to continuous or incidental contact, are exposed to crewmember's bare skin contact, protective equipment shall be provided to the crew and warning labels shall be provided at the surface site. This also applies to surfaces not normally exposed to the cabin in accordance with the NASA IVA Touch Temperature Safety interpretation letter JSC, MA2-95-048. (LS-71000, Section 6.4.3.2.1)

3.3.6.10 Continuous/Incidental Contact - Low Temperature

Not applicable.

3.3.6.11 Equipment Mounting

Equipment items used during nominal operations and planned maintenance shall be designed, labeled, or marked to protect against improper installation. (LS-71000, Section 6.4.4.2.1)

3.3.6.12 Drawers and Hinged Panels

Not applicable.

3.3.6.13 Alignment

Payload hardware having blind mate connectors shall provide guide pins or their equivalent to assist in alignment of hardware during installation. (LS-71000, Section 6.4.4.2.3)

3.3.6.14 Push-Pull Force

Not applicable.

3.3.6.15 Covers

Not applicable.

3.3.6.16 Self-Supporting Covers

Not applicable.

3.3.6.17 Accessibility

It shall be possible to mate/de-mate individual connectors without having to remove or mate/de-mate other connectors during nominal operations. (LS-71000, Section 6.4.4.3.2A)

3.3.6.18 Ease of Disconnect

A. Electrical connectors, which are mated/de-mated during nominal operations, shall require no more than two turns to disconnect. (LS-71000 6.4.4.3.3A)

B. Not applicable.

3.3.6.19 Self Locking

Payload electrical connectors shall provide a self-locking feature. (LS-71000, Section 6.4.4.3.5)

3.3.6.20 Connector Arrangement

A. Space between connectors and adjacent obstructions shall be a minimum of 25 mm (1 inch) for IVA access. (LS-71000, Section 6.4.4.3.6A)

B. Connectors in a single row or staggered rows which are removed sequentially by the crew IVA shall provide 25 mm (1 inch) of clearance from other connectors and/or adjacent obstructions for 270 degrees of sweep around each connector beginning at the start of its removal/replacement sequence. (LS-71000, Section 6.4.4.3.6B)

3.3.6.21 Arc Containment

Electrical connector plugs shall be designed to confine/isolate the mate/de-mate electrical arcs or sparks. (LS-71000, Section 6.4.4.3.7)

3.3.6.22 Connector Protection

Protection shall be provided for all de-mated connectors against physical damage and contamination. (LS-71000, Section 6.4.4.3.8)

3.3.6.23 Connector Shape

Payload connectors shall use different connector shapes, sizes or keying to prevent mating connectors when lines differ in content. (LS-71000, Section 6.4.4.3.9)

3.3.6.24 Alignment Marks or Guide Pins

Mating parts shall have alignment marks in a visible location during mating or guide pins (or their equivalent). (LS-71000, Section 6.4.4.3.11A)

3.3.6.25 Coding

A. Both halves of mating connectors shall display a code or identifier, which is unique to that connection. (LS-71000, Section 6.4.4.3.12A)

B. The labels or codes on connectors shall be located so they are visible when connected or disconnected. (LS-71000, Section 6.4.4.3.12B)

3.3.6.26 Pin Identification

Each pin shall be uniquely identifiable in each electrical plug and each electrical receptacle. At least every 10th pin must be labeled. (LS-71000, Section 6.4.4.3.13)

3.3.6.27 Orientation

Grouped plugs and receptacles shall be oriented so that the aligning pins or equivalent devices are in the same relative position. (LS-71000, Section 6.4.4.3.14)

3.3.6.28 Hose/Cable Restraints

A. Not applicable.

B. Not applicable.

C. Cables should be bundled if multiple cables are running in the same direction and the bundling does not cause EMI. (LS-71000, Section 6.4.4.3.15C)

D. Loose cables (longer than 0.33 meters (1 foot) shall be restrained as follows: (LS-71000, Section 6.4.4.3.15D):

Length (m)	Restraint Pattern (% of length) tolerances +/- 10%)
0.33-1.00	50
1.00-2.00	33,67
2.00-3.00	20, 40, 60, 80
>3.00	at least each 0.5 meters

3.3.6.29 Non-Threaded Fasteners Status Indication

An indication of correct engagement (hooking, latch fastening, or proper positioning of interfacing parts) of non-threaded fasteners shall be provided. (LS-71000, Section 6.4.4.4.1)

3.3.6.30 Mounting Bolt/Fastener Spacing

Clearance around fasteners to permit fastener hand threading (if necessary) shall be a minimum of 0.5 inches for the entire circumference of the bolt head and a minimum of 1.5 inches over 180 degrees of the bolt head and provide the tool handle sweep as seen in Figure 3.3.6.30-1. Excepted are NSTS standard middeck lockers or payload-provided hardware with the static envelope dimensions (cross-section) as specified in Figures 3.4.2.1-1, 3.4.2.2-1 and 3.4.2.3-1 of NSTS-21000-IDD-MDK and other similar captive fastener arrangements. (LS-71000, Section 6.4.4.4.2)

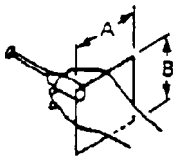
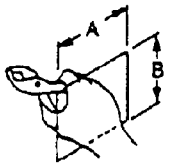
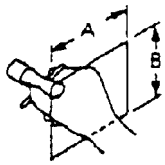
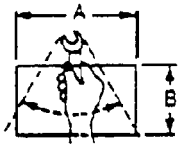
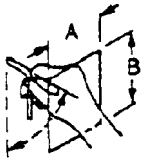
Opening dimensions		Task
	A 117 mm (4.6 in) B 107 mm (4.2 in)	Using common screwdriver with freedom to turn hand through 180°
	A 133 mm (5.2 in) B 115 mm (4.5 in)	Using pliers and similar tools
	A 155 mm (6.1 in) B 135 mm (5.3 in)	Using T-handle wrench with freedom to turn wrench through 180°
	A 203 mm (8.0 in) B 135 mm (5.3 in)	Using open-end wrench with freedom to turn wrench through 62°
	A 122 mm (4.8 in) B 155 mm (6.1 in)	Using Allen-type wrench with freedom to turn wrench through 62°

Figure 3.3.6.30-1. Minimal Clearance for Tool-Operated Fasteners

3.3.6.31 Multiple Fasteners

When several fasteners are used on one item they shall be of identical type. (LS-71000, Section 6.4.4.4.3)

NOTE: Phillips or Torque-Set fasteners may be used where fastener installation is permanent relative to planned on-orbit operations or maintenance, or where tool-fastener interface failure can be corrected by replacement of the unit containing the affected fastener with a spare unit. (LS-71000, Section 6.4.4.4.3)

3.3.6.32 Captive Fasteners

All fasteners planned to be installed and/or removed on-orbit shall be captive when disengaged. (LS-71000, Section 6.4.4.4.4)

3.3.6.33 Quick Release Fasteners

A. Quick release fasteners shall require a maximum of one complete turn to operate (quarter - turn fasteners are preferred). (LS-71000, Section 6.4.4.4.5A)

B. Quick release fasteners shall be positive locking in open and closed positions. (LS-71000, Section 6.4.4.4.5B)

3.3.6.34 Threaded Fasteners

Only right-handed threads shall be used. (LS-71000, Section 6.4.4.4.6)

3.3.6.35 Over Center Latches

Not applicable.

3.3.6.36 Winghead Fasteners

Not applicable.

3.3.6.37 Fastener Head Type

Not applicable.

3.3.6.38 One-Handed Actuation

Not applicable.

3.3.6.39 Deleted

3.3.6.40 Access Holes

Covers or shields through which mounting fasteners must pass for attachment to the basic chassis of the unit shall have holes for passage of the fastener without precise alignment (and hand or necessary tool if either is required to replace). (LS-71000, Section 6.4.4.4.12)

3.3.6.41 Controls Spacing Design Requirements

All spacing between controls and adjacent obstructions shall meet the minimum requirements as shown in Figure 3.3.6.41-1, Control Spacing Requirements for Ungloved Operation. (LS-71000, Section 6.4.5.1)

3.3.6.42 Protective Methods

Payloads shall provide protection against accidental control actuation using one or more of the protective methods listed in sub-paragraph A through G below. Infrequently used controls (i.e., those used for calibration) should be separated from frequently used controls. Leverlock switches or switch covers are strongly recommended for switches related to mission success. Switch guards may not be sufficient to prevent accidental actuation. (LS-71000, Section 6.4.5.1)

A. Locate and orient the controls so that the operator is not likely to strike or move them accidentally in the normal sequence of control movements. (LS-71000, Section 6.4.5.2.1A)

B. Recess, shield, or otherwise surround the controls by physical barriers. The control shall be entirely contained within the envelope described by the recess or barrier. (LS-71000, Section 6.4.5.2.1B)

C. Cover or guard the controls. Safety or lock wire shall not be used. (LS-71000, Section 6.4.5.2.1C)

D. Cover guards when open shall not cover or obscure the protected control or adjacent controls. (LS-71000, Section 6.4.5.2.1D)

E. Provide the controls with interlocks so that extra movement (e.g., lifting switch out of a locked detent position) or the prior operation of a related or locking control is required. (LS-71000, Section 6.4.5.2.1E)

F. Provide the controls with resistance (i.e., viscous or coulomb friction, spring-loading, or inertia) so that definite or sustained effort is required for actuation. (LS-71000, Section 6.4.5.2.1F)

G. Provide the controls with a lock to prevent the control from passing through a position without delay when strict sequential actuation is necessary (i.e., the control moved only to the next position, then delayed). (LS-71000, Section 6.4.5.2.1G)

3.3.6.43 Noninterference

Payload provided protective devices shall not cover or obscure other displays or controls. (LS-71000, Section 6.4.5.2.2)

3.3.6.44 Dead-Man Controls

Not applicable.

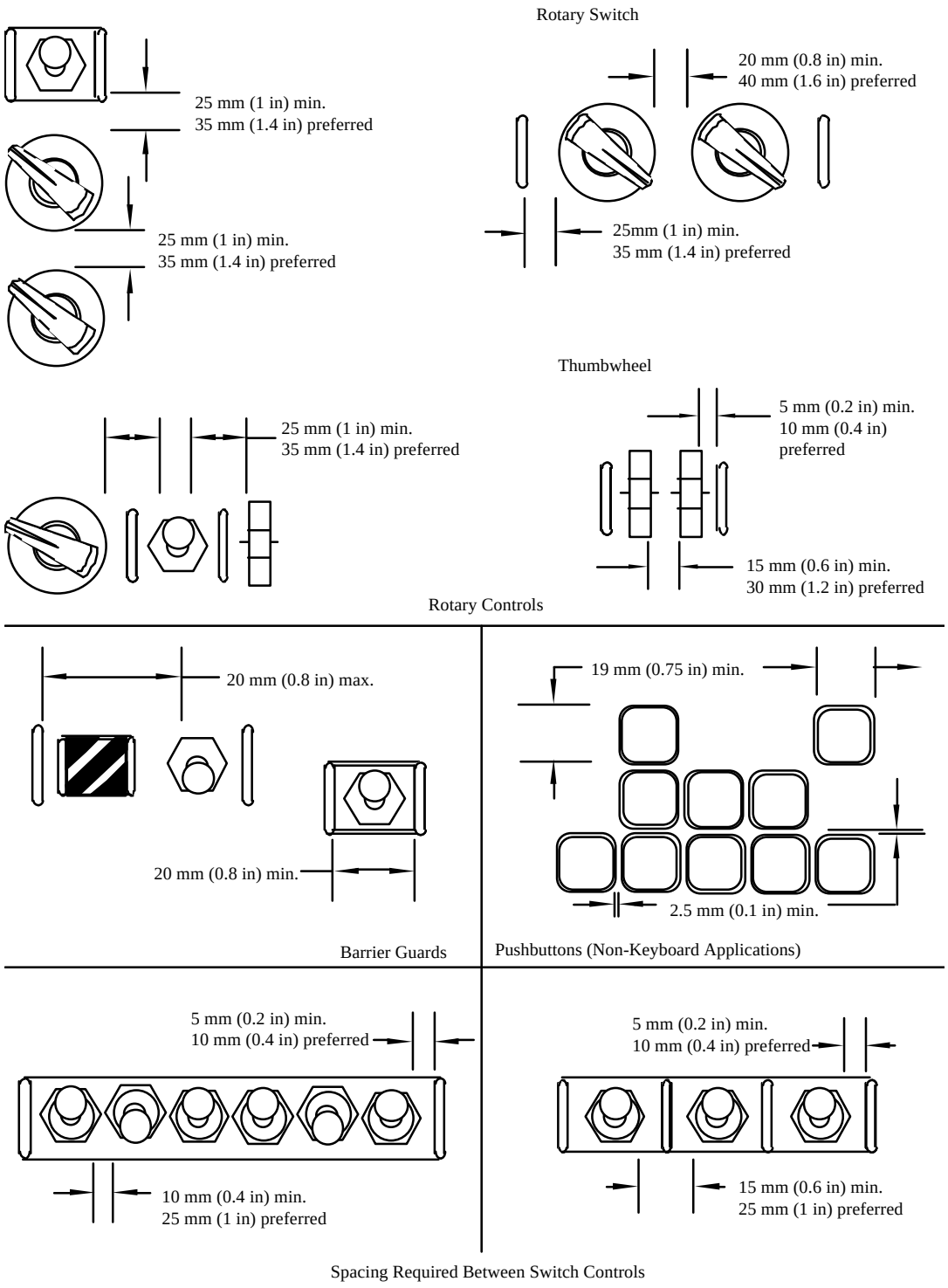


Figure 3.3.6.41-1. Control Spacing Requirements for Ungloved Operation

NOTE: Displays and controls used only for maintenance and adjustments, which could disrupt normal operations if activated, should be protected during normal operations (e.g., by being located separately or guarded/covered).

3.3.6.45 Barrier Guards

Barrier guard spacing shall adhere to the requirements for use with the toggle switches, rotary switches, and thumbwheels as shown in Figures 3.3.6.41-1, Control Spacing Requirements for Ungloved Operation and 3.3.6.45-1, Rotary Switch Guard. (LS-71000, Section 6.4.5.2.4)

3.3.6.46 Recessed Switch Protection

Not applicable.

3.3.6.47 Position Indication

Not applicable.

3.3.6.48 Hidden Controls

Not applicable.

3.3.6.49 Hand Controllers

Not applicable.

3.3.6.50 Valve Controls

Not applicable.

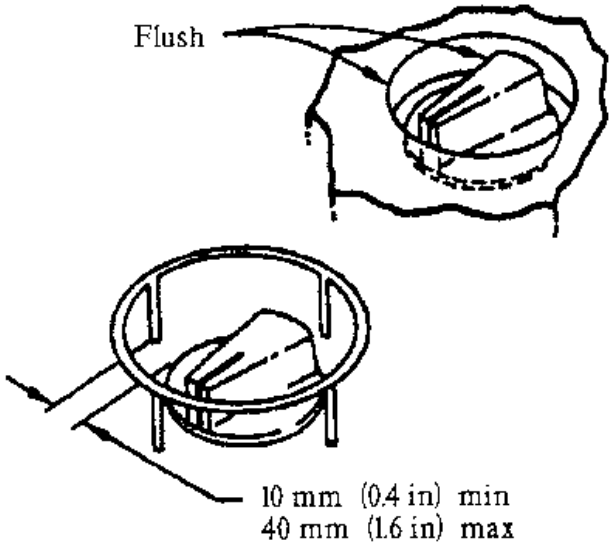


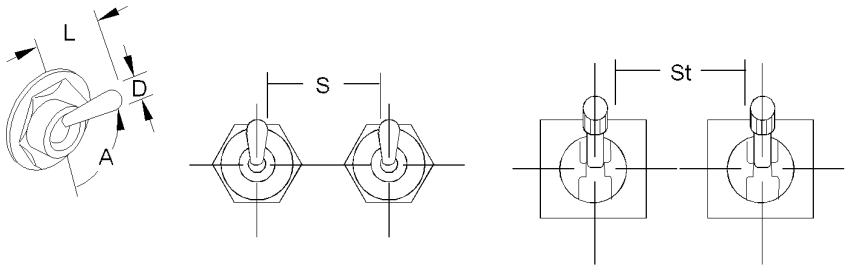
Figure 3.3.6.45-1. Rotary Switch Guard

3.3.6.51 Toggle Switches

Dimensions for a standard toggle switch shall conform to the values presented in Figure 3.3.6.51-1, Toggle Switches. (LS-71000, Section 6.4.5.4)

3.3.6.52 Restraints and Mobility Aids

Payloads shall be designed such that all installation, operation, and maintenance can be performed using standard crew restraints, mobility aids, and interfaces as defined in SSP 30257:004. (LS-71000, Section 6.4.6)



	Dimensions		Resistance	
	L Arm Length	D Control Tip	Small Switch	Large Switch
Minimum	13 mm (1/2 in.)	3 mm (1/8 in.)	2.8 N (10 oz)	2.8 N (10 oz.)
Maximum	50 mm (2 in.)	25 mm (1 in.)	4.5 N (16 oz.)	11 N (40 oz.)

	Displacement between positions	
	A	
	2 position	3 position
Minimum	30°	17°
Maximum	80°	40°
Desired		25°

	Separation			
	Single finger operation	†	S Single finger sequential operation	Simultaneous operation by different fingers
Minimum	19 mm (3/4 in.)	25 mm (1 in.)	13 mm (1/2 in.)	16 mm (5/8 in.)
Optimum	50 mm (2 in.)	50 mm (2 in.)	25 mm (1 in.)	19 mm (3/4 in.)

† Using a lever lock toggle switch

Figure 3.3.6.51-1. Toggle Switches

3.3.6.53 Deleted

3.3.6.54 Captive Parts

The Mobility hardware equipment shall be designed in such a manner to ensure that all unrestrained parts (e.g., locking pins, knobs, handles, lens covers, access plates, or similar devices) that may be temporarily removed on-orbit will be tethered or otherwise held captive. (LS-71000, Section 6.4.6.3)

3.3.6.55 Handles and Restraints

All removable or portable items, which cannot be grasped with one hand, as per Table 3.3.6.55-1 [*TBD, referenced table is not included in SSP 57000*], shall be provided with handles or other suitable means of grasping, tethering, carrying, and restraining. (LS-71000, Section 6.4.6.4.1)

3.3.6.56 Handle Location/Front Access

Handles and grasp areas shall be placed on the accessible surface of a payload item consistent with the removal direction. (LS-71000, Section 6.4.6.4.2)

3.3.6.57 Handle Dimensions

IVA handles for movable or portable units shall be designed in accordance with the minimum applicable dimensions in Figure 3.3.6.57-1. (LS-71000, Section 6.4.6.4.3)

3.3.6.58 Non-Fixed Handles Design Requirements

Not applicable.

3.3.6.59 Electrical Hazards

Electrical equipment other than bioinstrumentation equipment will incorporate the following controls as specified below:

A. If the exposure condition is below the threshold for shock (i.e., below maximum leakage current and voltage requirements as defined within this section), no controls are required. Non-patient equipment with internal voltages not exceeding 30 V rms or DC nominal (32 V rms or DC maximum) will contain potentials below the threshold for electrical shock. (LS-71000, Section 6.4.9.1A)

B. If the exposure condition exceeds the threshold for shock, but is below the threshold of the let-go current profile (critical hazard) as defined in Table 3.3.6.59-1, two independent controls (e.g., a safety (green) wire, bonding, insulation, leakage current levels below maximum requirements) shall be provided such that no single failure, event, or environment can eliminate more than one control. (LS-71000, Section 6.4.9.1B)

C. If the exposure condition exceeds both the threshold for shock and the threshold of the let-go current profile (catastrophic hazardous events) as defined in Table 3.3.6.59-1, three independent controls shall be provided such that no combination of two failures, events, or environments can eliminate more than two controls. (LS-71000, Section 6.4.9.1C)

D. If two dependent controls are provided, the physiological effect that a crew member experiences as a result of the combinations of the highest internal voltage applied to or generated within the equipment and the frequency and wave form associated with a worst case credible failure shall be below the threshold of the let-go current profile as defined in Table 3.3.6.59-1. (LS-71000, Section 6.4.9.1D)

E. If it cannot be demonstrated that the hazard meets the conditions of paragraph A, B, or C above, three independent hazard controls shall be provided such that no combination of two failures, events, or environments can eliminate more than two controls. (LS-71000, Section 6.4.9.1E)

TABLE 3.3.6.59-1. LET-GO CURRENT PROFILE, THRESHOLD VERSUS FREQUENCY

Frequency (Hertz)	Maximum Total Peak Current (AC + DC components combined) milliamperes
DC	40.0
15	8.5
2000	8.5
3000	13.5
4000	15.0
5000	16.5
6000	17.9
7000	19.4
8000	20.9
9000	22.5
10000	24.3
50000	24.3
(Based on 99.5 Percentile Rank of Adults)	

3.3.6.60 Mismatched

A. The design of electrical connectors shall make it impossible to inadvertently reverse a connection or mate the wrong connectors if a hazardous condition can be created. (LS-71000, Section 6.4.9.1.1A)

B. Payload and on-orbit support equipment, wire harnesses, and connectors shall be designed such that no blind connections or disconnections must be made during payload installation, operation, removal, or maintenance on orbit unless the design includes scoop proof connectors or other protective features (NSTS 1700.7B, ISS Addendum, paragraph 221). (LS-71000, Section 6.4.9.1.1B)

C. For payload equipment, for which mismating or cross-connection may damage ISS-provided equipment, plugs, and receptacles (connectors), shall be selected and applied such that they cannot be mismatched or cross-connected in the intended system as well as adjacent systems. Although identification markings or labels are required, the use of identification alone is not sufficient to preclude mismating. (LS-71000, Section 6.4.9.1.1C)

D. For all other payload connections, combinations of identification, keying and clocking, and equipment test and checkout procedures shall be employed at the payload's discretion to minimize equipment risk while maximizing on-orbit operability. (LS-71000, Section 6.4.9.1.1D)

3.3.6.61 Device Accessibility

An overload protective device shall not be accessible without opening a door or cover, except that an operating handle or operating button of a circuit breaker, the cap of an extractor-type fuse holder, and similar parts may project outside the enclosure. (LS-71000, Section 6.4.9.1.2.1)

3.3.6.62 Extractor -Type Fuse Holder

The design of the extractor-type fuse holder shall be such that the fuse is extracted when the cap is removed. (LS-71000, Section 6.4.9.1.2.2)

3.3.6.63 Overload Protection Location

Overload protection (fuses and circuit breakers) intended to be manually replaced or physically reset on-orbit shall be located where they can be seen and replaced or reset without removing other components. (LS-71000, Section 6.4.9.1.2.3)

3.3.6.64 Overload Protection Identification

Each overload protector (fuse or circuit breaker) intended to be manually replaced or physically reset on-orbit shall be readily identified or keyed for its proper value. (LS-71000, Section 6.4.9.1.2.4)

3.3.6.65 Automatic Restart Protection

Controls shall be employed that prevent automatic restarting after an overload-initiated shutdown. (LS-71000, Section 6.4.9.1.2.5)

3.3.6.66 Audio Devices (Displays)

Not applicable.

3.3.6.67 Egress

All payload egress requirements shall be in accordance with NSTS 1700.7B, ISS Addendum, paragraph 205. (LS-71000, Section 6.4.9.11)

3.3.7 System Security

3.3.8 Design Requirements

3.3.8.1 Structural Design Requirements

A. The Mobility hardware shall maintain positive margins of safety for launch and landing loading for the carriers in which it will be transported:

1. MPLM Launch and Landing Loading - For early design, the acceleration environment defined in Table 3.3.8.1-1, "Payload Mounted Equipment Load

Factors (Equipment Frequency 35 Hz)" will be used. These load factors will be superseded by load factors obtained through ISS-performed Coupled Loads Analysis as described in SSP 52005. (SSP57000, Section 3.1.1.3F)

2. Orbiter Middeck Launch and Landing Loading – based upon acceleration environment as defined in NSTS-21000-IDD-MDK, Table 4.1-1. (LS-71000, Section 6.3.1.3A)

TABLE 3.3.8.1-1. PAYLOAD MOUNTED EQUIPMENT LOAD FACTORS (EQUIPMENT FREQUENCY 35 HZ)

Liftoff	**X**	**Y**	**Z**
(g)	± 7.7	± 11.6	± 9.9
Landing	**X**	**Y**	**Z**
(g)	± 5.4	± 7.7	± 8.8

NOTE: Load factors apply concurrently in all possible combinations for each event and are shown in the rack coordinate system defined in SSP 41017, Part 2, and paragraph 3.1.3.

B. EUE shall provide positive margins of safety for on-orbit loads of 0.2 Gs acting in any direction. (LS-71000, Section 6.3.1.3B)

3.3.8.1.1 Crew Induced Load Requirements

EUE shall provide positive margins of safety when exposed to the crew induced loads defined in Table 3.3.8.1.1-1, Crew-Induced Loads. (LS-71000, Section 6.3.1.3C)

TABLE 3.3.8.1.1-1. CREW-INDUCED LOADS

Crew System or Structure	Type of Load	Load	Direction of Load
Levers, Handles, Operating Wheels, Controls	Push or Pull concentrated on most extreme edge	222.6 N (50 lbf), limit	Any direction
Small Knobs	Twist (torsion)	14.9 N-m (11 ft-lbf), limit	Either direction
Exposed Utility Lines (Gas, Fluid, and Vacuum)	Push or Pull	222.6 N (50 lbf)	Any direction
Rack front panels and any other normally exposed equipment	Load distributed over a 4 inch by 4 inch area	556.4 N (125 lbf), limit	Any direction

Legend:
ft = feet, m = meter, N = Newton, lbf = pounds force

3.3.8.1.2 Safety Critical Structures Requirements

Not applicable.

3.3.8.1.3 Loads Requirements

Not applicable.

3.3.8.2 Electrical Power Consuming Equipment Design

3.3.8.2.1 Batteries

All battery systems shall meet the requirements of NSTS 1700.7, ISS addendum, Section 213.2. (Derived from LS-71000, Section 6.3.2.10)

3.3.8.3 Pressurized Gas Bottle Design

Not applicable.

3.4 ACCEPTANCE AND QUALIFICATION REQUIREMENTS

3.4.1 Thermal Environment Compatibility

A. Mobility hardware shall operate nominally during exposure to 10 °C to 35 °C (50 °F to 95 °F).

NOTE: ISS environment specifications will maintain a cabin temperature between 17 °C to 28 °C (63 °F to 82 °F) during Orbiter launch, transfer to ISS and while on-board ISS. The above temperature range was selected to ensure adequate functionality over time given the ISS environment.

B. Mobility hardware shall operate nominally following exposure to 10 °C to 46 °C (50 °F to 115 °F).

3.4.2 Workmanship Vibration

Mobility hardware shall operate nominally following vibration at workmanship levels.

3.4.3 Functional Performance

Mobility hardware shall complete a functional test as outlined in a TPS or functional test plan.

3.4.4 Electrical, Electronic, and Electromechanical Parts Control, Selection, and Burn-In

A. Parts control shall be in accordance with SSP 30312, “Electrical, Electronic and Electromechanical (EEE) and Mechanical Parts Management and Implementation Plan for Space Station Program.”

B. Parts selection for equipment shall be in accordance with:

1. SSP 30423, “Space Station Approved Electrical, Electronic and Electromechanical (EEE) Parts List.”
2. SSQ 25002, “Supplemental List of Qualified Electrical, Electronic, Electromechanical (EEE) Parts, Manufacturers, and Laboratories (QEPM&L).”
3. Semiconductors shall be JANTXV in accordance with MIL-PRF-19500, “Performance Specification Semiconductor Devices, General Specification for.” Diodes shall have a metallurgical bond. Passive parts shall be at least the second highest level of appropriate Military Established Reliability (MIL-ER).

4. SSP 30512C, “Space Station Ionizing Radiation Design Environment.”

Where no alternative is available, nonmilitary parts, components, and subassemblies may be used, but burn-in screening of these items shall be performed per 3.4.4C.

C. Burn-in screening shall be completed (100%) on all flight hardware (units).

3.4.5 Flammability

All Mobility hardware shall meet the flammability test requirements as described in 4.3.5.

3.4.6 Offgassing

All Mobility hardware located in inhabitable areas shall meet the offgassing test requirements as described in 4.3.6.

3.4.7 Bench Handling

All Mobility hardware shall meet the requirements as described in 4.3.7.

3.4.8 Payload Mass

All Mobility hardware shall meet the payload mass control requirements as described in 4.3.8.

3.4.9 Electromagnetic Compatibility

All Mobility hardware shall meet the EMC control requirements as described in 4.3.9.

3.4.10 Acoustic Noise

All Mobility hardware shall meet the acoustic noise control requirements as described in 4.3.10.

3.4.11 Software Acceptance

Not applicable.

3.4.12 Pre-Delivery Acceptance

All Mobility hardware equipment shall meet the pre-delivery acceptance requirements as described in 4.3.12. (LS-71000, Section 5.4.1.3.2)

3.5 HUMAN RESEARCH PROGRAM REQUIREMENTS

3.5.1 Safety

The Mobility hardware shall meet the applicable requirements of NSTS 1700.7, NSTS 1700.7B ISS Addendum, NSTS/ISS 18798, NSTS/ISS 13830, and KHB 1700.7.

3.5.2 Documentation Requirements

Documentation requirements for Mobility hardware shall be as specified in Appendix A of the PRD for HRF, LS-71000. Required items for submittal to NASA are summarized below for convenience.

3.5.2.1 Acceptance Data Package

The contents of the Acceptance Data Package (ADP) shall be based upon SSP 30695, Acceptance Data Package Requirements Specification, but shall also include the following:

#	Document	Required for Project		Comments
		Yes	No	
1	Engineering Drawings	✓		
2	Inventory of Serialized Components	✓		
3	Operating, Maintenance, and Handling Procedures	✓		
4	"As run" Test Procedures, Data, and Reports	✓		
5	Safety Data	✓		
6	Structural Analyses	✓		
7	Radioactive Material Data	✓		
8	Calibration Data	✓		

1. Engineering Drawings: As-built engineering drawings shall be provided. The drawings shall include the top assembly drawing for each major component and any other drawings necessary to perform receiving inspection and any test or operation to be performed at the destination.
2. Inventory of Serialized Components: A list of "field replaceable" serialized components will be included in the ADP. The list will contain the component part number, component name, and component serial number.
3. Operating, Maintenance, and Handling Procedures: Each delivered functional end item shall have a separate manual covering its maintenance, repair, and operation. The manual shall include, but not be limited to, the following (as applicable):
   a. Operational instructions suitable to support operator training and containing a system description and general instructions for operating the equipment.
   b. Any special handling, packing, transportation, or storage procedures (i.e., must be stored/transported in a specific orientation, specific environmental conditions, etc.)
   c. A list of special tools, support and facilities equipment and all other materials necessary to perform maintenance.
   d. A schedule chart listing the time at which all maintenance is to be performed. This shall also include inspection for required repair, maintenance, or replacement of parts.

e. Conditions of environment in which maintenance is to be performed.

f. Detailed maintenance procedures that describe removal, disassembly, type of maintenance or repair, cleaning, reassemble and reinstallation of all parts or subassemblies. Also included shall be points of inspection and notes of caution.

g. Illustrated part breakdowns showing the details of the part being worked upon.

h. Schematic and interconnecting wiring diagrams in sufficient detail to enable troubleshooting to be performed down to the replaceable subassembly or printed circuit board level.

i. Fault analysis will be provided to facilitate maintenance. The repair procedures shall be adequate for testing, checkout, disassembly, cleaning, inspection, repair, reassembly, adjustment, calibration, and servicing of the equipment as applicable.

4. "As Run" Test Procedures and Reports: The original "as run" test procedures used for any of the testing required in this System Requirements Document (SRD), along with any associated data and test reports shall be included in the ADP. These procedures shall include quality buy-off if applicable as documented in the Quality Plan.

5. Safety Data: Copies of hazard reports and other safety data prepared or collected as a result of ground and/or flight safety requirements.

6. Structural Analyses: Copies of any structural analyses performed as specified in this SRD or required in the contract with National Aeronautics and Space Administration (NASA).

7. Radioactive Material Data: If the shipment contains any radioactive material, this section shall include copies of all required data on radioactive material.

8. Calibration Data: This section shall include any calibration or scaling data required to interpret the output signals from or measurements made using the equipment being shipped.

3.5.2.1.1 Acceptance Data Package Statement in Statement of Work

The SOW for procured flight items shall contain a DRD specifying the above ADP contents.

3.5.2.2 Additional Required Documentation

4.0 VERIFICATION PROVISIONS

This section contains the required verification methods for ISS interface certification, science functional acceptance, program qualification and acceptance, and Russian Interface verification.

Section 4.1 addresses definitions for terms used in verification of requirements. Appendix B contains the applicability matrix for ISS Pressurized Payload Interface Requirements Document requirements.

Section 4.3 contains the verification methods for program qualification and acceptance requirements. Appendix D contains the applicability matrices for acceptance and qualification requirements.

The responsibility for the performance of all verification activities is as specified in Appendices B, C, D, and E. All testing described in Appendices B, C, D and E shall be documented via TPS (JSC Form 1225) per JSC Work Instruction NT-CWI-001. Except as otherwise specified in the contract, the provider may use their own or any other facility suitable for the performance of the verification requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the verifications set forth in this specification.

4.1 GENERAL

Equipment verification methods are defined as follows:

A. Inspection is a method that determines conformance to requirements by the review of drawings, data or by visual examination of the item using standard quality control methods, without the use of special laboratory procedures.

B. Analysis is a process used in lieu of, or in addition to, other methods to ensure compliance to specification requirements. The selected techniques may include, but not be limited to, engineering analysis, statistics and qualitative analysis, computer and hardware simulations, and analog modeling. Analysis may also include assessing the results of lower level qualification activity. Analysis may be used when it can be determined that (1) rigorous and accurate analysis is possible, (2) test is not cost effective and (3) verification by inspection is not adequate.

   Verification by similarity is the process of analyzing the specification criteria for hardware configuration and application for an article to determine if it is similar or identical in design, manufacturing process and quality control to an existing article that has previously been qualified to equivalent or more stringent specification criteria. Special effort will be made to avoid duplication of previous tests from this or similar programs. If the previous application is considered to be similar, but not equal to or greater in severity, additional qualification tests shall concentrate on the areas of new or increased requirements.

C. Demonstration consists of a qualitative determination of the properties of a test article. This qualitative determination is made through observation, with or without special test equipment or instrumentation, which verifies

characteristics such as human engineering features, services, access features, and transportability. Demonstration requirements are normally implemented within a test plan, operations plan, or test procedure.

D. Test is a method in which technical means, such as the use of special equipment, instrumentation, simulation techniques, and the application of established principles and procedures, are used for the evaluation of components, subsystems, and systems to determine compliance with requirements. Test shall be selected as the primary method when analytical techniques do not produce adequate results; failure modes exist which could compromise personnel safety, adversely affect flight systems or payload operation, or result in a loss of mission objectives; or for any components directly associated with Space Station and orbiter interfaces. The analysis of data derived from tests is an integral part of the test program and should not be confused with analysis as defined above.

4.2 DELETED

4.3 ACCEPTANCE AND QUALIFICATION VERIFICATION METHODS

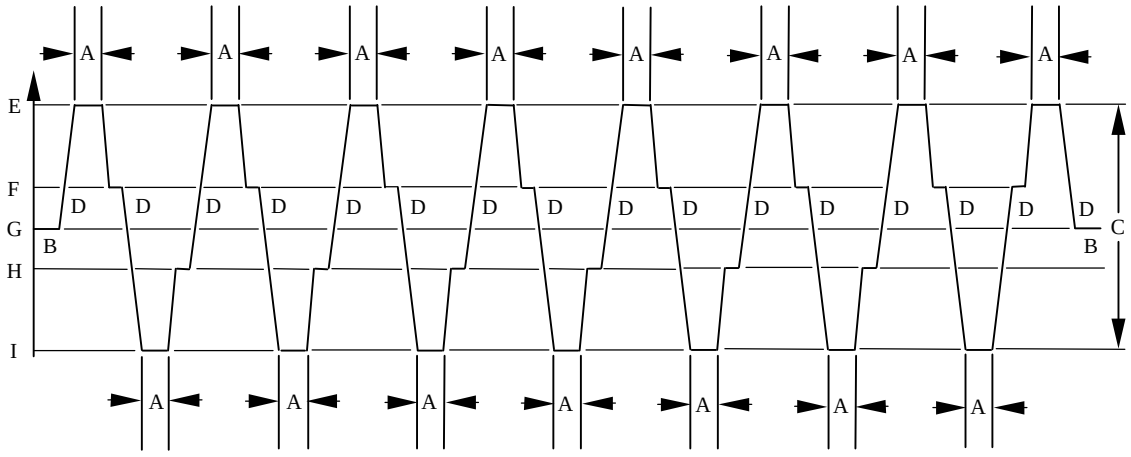
The requirements herein describe specific test requirements for Mobility hardware acceptance and qualification. Qualification testing shall only be performed if qualification articles exist for the hardware. If no qualification articles exist for the hardware, analysis may be used to qualify the hardware.

4.3.1 Thermal Cycle Tests

HRF payloads undergoing thermal cycle testing shall be functionally tested at each stable temperature and during transitions. The pass-fail criteria for the functional test and the definition of the functional test will be equipment unique and shall be defined in the test plan and test procedure. Functional tests shall be conducted on end items prior to, during, and after environmental exposure. (LS-71000, Section 5.4.1.1.6)

4.3.1.1 Qualification Thermal Cycle Test

The Qualification Thermal Cycle Test shall be conducted over a temperature range of 61.1 °C (110 °F) centered around the midpoint of the normal operating temperature as defined in Section 3.4.1.A. The Qualification thermal test shall consist of 7½ cycles. One cycle is defined as starting from normal operating temperature, increasing to the maximum high temperature, decreasing to the minimum low temperature, and then returning to the normal operating temperature as depicted in Figure 4.3.1.1-1. The complete test is seven and one-half (7½) cycles with one-hour soaks at each extreme. The hardware will be functionally tested during transitions and at the highest and lowest temperature extremes, consistent with the defined operating temperature range. The hardware shall not be functionally tested at temperatures in excess of the defined operating temperature range. (Hardware shall be unpowered when outside the manufacturer's operating limits.) The specific profile shall be defined in the individual test plans. (LS-71000, Section 5.4.1.1.6.1)

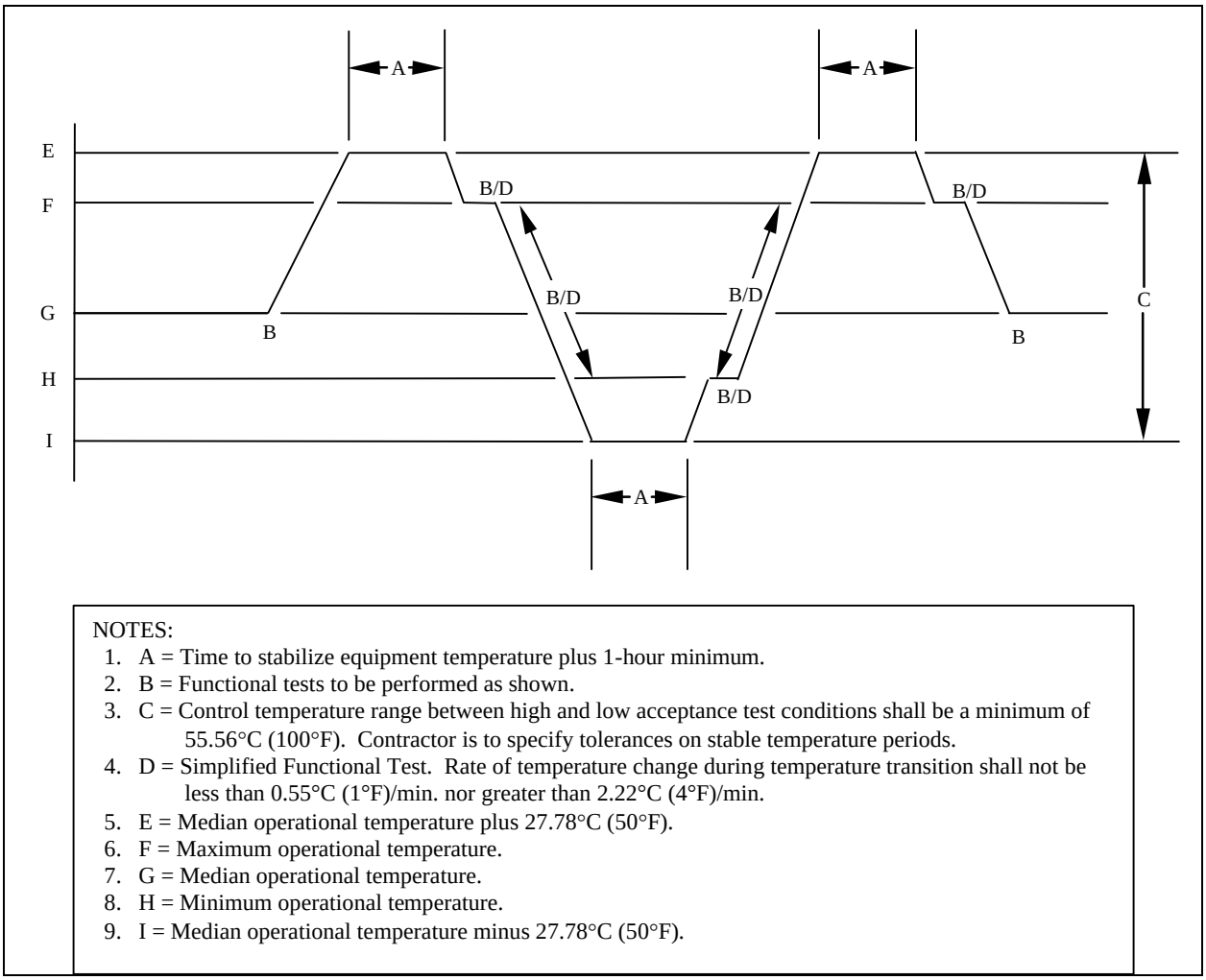


NOTES:
1. A = Time to stabilize equipment temperature plus 1-hour minimum.
2. B = Functional tests to be performed as shown.
3. C = Control temperature range between high and low acceptance test conditions shall be a minimum of 61.11°C (110°F). Contractor is to specify tolerances on stable temperature periods.
4. D = Simplified Functional Test. Rate of temperature change during temperature transition shall not be less than 0.55°C (1°F)/min. nor greater than 2.22°C (4°F)/min.
5. E = Median operational temperature plus 30.56°C (55°F).
6. F = Maximum operational temperature.
7. G = Median operational temperature.
8. H = Minimum operational temperature.
9. I = Median operational temperature minus 30.56°C (55°F).

Figure 4.3.1.1-1. Qualification Thermal Cycling

4.3.1.2 Acceptance Thermal Cycling

The acceptance thermal cycle shall be conducted over a temperature range of 55.6 °C (100 °F) centered around the midpoint of the normal operating temperature as defined in Section 3.4.1.A. The hardware shall be functionally tested before and after the temperature test, at each transition, and at each stable temperature. The hardware shall not be functionally tested at temperatures in excess of the defined operating temperature range. (Hardware shall be unpowered when outside the manufacturer's operating limits.) One cycle is defined as starting from normal operating temperature, increasing to the maximum high temperature, decreasing to the minimum low temperature, and then returning to the normal operating temperature as depicted in Figure 4.3.1.2-1. The complete test consists of one and one-half (1½) thermal cycles with one-hour soaks at each extreme. Minimum temperature sweep shall be 100 °F around the normal operating temperature and the hardware shall dwell at the temperature extremes for a minimum of 1 hour**.** (LS-71000, Section 5.4.1.1.6.2)



NOTES:
1. A = Time to stabilize equipment temperature plus 1-hour minimum.
2. B = Functional tests to be performed as shown.
3. C = Control temperature range between high and low acceptance test conditions shall be a minimum of 55.56°C (100°F). Contractor is to specify tolerances on stable temperature periods.
4. D = Simplified Functional Test. Rate of temperature change during temperature transition shall not be less than 0.55°C (1°F)/min. nor greater than 2.22°C (4°F)/min.
5. E = Median operational temperature plus 27.78°C (50°F).
6. F = Maximum operational temperature.
7. G = Median operational temperature.
8. H = Minimum operational temperature.
9. I = Median operational temperature minus 27.78°C (50°F).

Figure 4.3.1.2-1. Acceptance Thermal Cycling

4.3.2 Vibration Tests

Qualification for Acceptance Vibration Test levels are as described in Section 4.3.2.1. Acceptance Vibration Test levels are as described in Section 4.3.2.2.

4.3.2.1 Qualification for Acceptance Vibration Test

Not applicable.

4.3.2.2 Acceptance Vibration Test

AVT is used to screen defects in workmanship that cannot be detected by inspection. AVT for Mobility hardware shall be performed at a 6.1 g rms composite level over the frequency range and minimum AVT levels defined in Table 4.3.2.2-1. Vibration duration shall be a minimum of 60 seconds in each of three axes. Functional/continuity tests shall be conducted on components before, during, and after the AVT. (LS-71000 Section 5.4.1.1.3.3)

NOTE: Mobility hardware will take exception to this requirement.

TABLE 4.3.2.2-1. ACCEPTANCE VIBRATION TEST LEVELS

Frequency Range (Hz)	Minimum Power Spectral Density (g^2/Hz)
20	0.01
20 - 80	+3 dB/Octave - Slope
80 - 350	0.04
350 - 2000	-3 dB/Octave - Slope
2000	0.007
Composite	6.1 g rms

4.3.3 Functional Testing

The scope and method of functional testing shall be negotiated between the hardware developer and the quality organization responsible for accepting the hardware and software. (LS-71000, Section 5.4.1.3.4)

4.3.4 Electrical, Electronic and Electromechanical Parts Control, Selection and Burn-In

A Compliance with 3.4.4.A is considered successful when it can be shown via analysis that the parts control process is compliant with 3.4.4.A.

B. Compliance with 3.4.4.B is considered successful when an analysis is provided that includes a risk assessment, electrical stress analysis, and data delivery on information such as designed/as-built EEE parts, list, construction history, Government and Industry Data Exchange Program (GIDEP) Alerts, part obsolescence, radiation susceptibility and/or prior history.

C. The burn-in test may be accomplished at the component or assembly level, and is specified as:

- 72 hrs continuously at room ambient temperature while functioning
- 96 hrs continuously at a specified controlled temperature while functioning.

Full functional tests shall be performed on the experiment hardware before and after the burn-in test. Controlled temperature is defined as 15 °C below the maximum rating of the device with the lowest temperature rating in the article under test. (LS-71000, Section 5.4.1.1.10)

4.3.5 Flammability

Payload materials shall be non-flammable or self-extinguishing per the test criteria of NASA-STD-6001, Test 1, Flammability, Odor, Offgassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion. The material shall be evaluated in the worst-case use environment at the worst-case use configuration. When the use of a nonflammable material is not possible, a Material Usage Agreement (MUA) or equivalent shall be submitted to the cognizant NASA center for disposition. If test data does not exist for a material, the experimenter may be asked to provide samples (see NASA-STD-6001, Chapter 4) to a NASA certified test facility such as Marshall Space Flight Center (MSFC) or White Sands Test Facility (WSTF) for flammability testing).

Materials transported or operated in the orbiter cabin, or operated in the ISS air lock during Extravehicular Activity (EVA) preparations, shall be tested and evaluated for flammability in the worst-case use environment of 30% oxygen and 10.2 psia. Materials used in all other habitable areas shall be tested and evaluated in the worst-case use environment of 24.1% oxygen and 15.2 psia. (LS-71000, Section 5.4.1.1.8)

4.3.6 Offgassing

All flight hardware located in habitable areas shall be subjected to test and meet the toxicity offgassing acceptance requirements of NASA-STD-6001, Test 7. (LS-71000, Section 5.4.1.1.9)

4.3.7 Bench Handling

A bench handling test shall be performed on the qualification unit for all stowed hardware. The bench handling test shall be conducted in accordance with MIL-STD-810, Section 516.4, I-3.8, Procedure VI with the following modifications: Number of actual drops depends upon hardware configuration and will be negotiated with JSC/NT prior to testing. Surfaces, corners, edges shall be identified in the test procedure. (LS-71000, Section 5.4.1.1.5)

4.3.8 Payload Mass

The Mobility hardware shall comply with LS-71014, Mass Properties Control Plan Human Research Facility Payload and Racks (draft). (LS-71000, Section 5.4.1.1.1)

4.3.9 Electromagnetic Compatibility

The Mobility hardware shall comply with LS-71016, Electromagnetic Compatibility Control Plan for the Human Research Facility. (LS-71000, Section 5.4.1.2.1)

4.3.10 Acoustic Noise

The Mobility hardware shall comply with LS-71011, Acoustic Noise Control and Analysis Plan for Human Research Facility Payloads and Racks. (LS-71000, Section 5.4.1.1.7)

4.3.11 Software Acceptance

Not applicable.

4.3.12 Pre-Delivery Acceptance

The responsible manufacturing parties shall perform a Pre-Delivery Acceptance (PDA) after the complete fabrication and assembly has been conducted for all Class I deliverable assemblies. This test shall include verification of software interface and operation. The PDA must be completed before hardware certification testing begins. It is a full functional test and inspection that validates that the hardware operates per the design requirements and that it is constructed per released engineering drawings. All PDA tests shall be approved by the

hardware's JSC technical monitor and JSC/NT3, as well as the contractor quality engineering (if applicable). The following are standard steps that each PDA test shall contain:

A. Conformance to Drawing. Verify that the hardware conforms to released engineering drawings.

B. No Sharp Edges. Inspect the hardware to verify that there are no sharp edges or corners present.

C. Proper Identifying Markings. Verify that the hardware has the proper part number and serial number (if applicable) on it.

D. Cleanliness. All PDA tests shall include verification that all surfaces (external, internal, etc.) are to the cleanliness level of Section 3.3.1.1C of this document.

(LS-71000, Section 5.4.1.3.2)

5.0 PREPARATION FOR SHIPMENT

5.1 GENERAL

A. The methods of preservation, packaging, and packing used for shipment, together with necessary special control during transportation, shall adequately protect the article(s) from damage or degradation in reliability or performance as a result of the natural and induced environments encountered during transportation and subsequent indoor storage. (LS-71000, Section 9.1A)

B. To reduce program cost, prior to developing a newly designed container, every effort will be made by project participants to use container designs and/or containers available commercially or from Government inventories. If reusable containers are not available, a screening process should be initiated for container availability in the following priority: existing containers, commercial off-the-shelf containers, and modified commercial off-the shelf containers. Shipping containers and protective devices will be designed for effective and economical manufacture, procurement, and transportability. (LS-71000, Section 9.1B)

5.2 PACKING, HANDLING AND TRANSPORTATION

A. Packaging, handling and transportation shall be in accordance with applicable requirements of NHB 6000.1C, and referenced documents therein. (LS-71000, Section 9.2A)

B. Documented procedures and physical controls shall be established to ensure that the HRF rack and individual items of equipment will not be subjected to temperature, shock, and humidity outside the non-operational limits during shipment. (LS-71000, Section 9.2C)

C. The Mobility hardware shall be cleaned to the “Visibly Clean Level 1 (Sensitive)” as determined in SN-C-0005, Specification Contamination Control Requirements for the Shuttle Program. (LS-71000, Section 9.2D)

5.3 PRESERVATION AND PACKING

Preservation and packing shall be in accordance with approved Packaging, Handling, and Transportation Records (PHTRs). (LS-71000, Section 9.3)

5.4 MARKING FOR SHIPMENT

Interior and exterior containers shall be marked and labeled in accordance with NHB 6000.1C, including precautionary markings necessary to ensure safety of personnel and facilities, and to ensure safe handling, transport and storage. Should the individual items of equipment contain any hazardous materials, markings shall also comply with applicable requirements governing packaging and labeling of hazard materials. Packages with reuse capability shall be identified with the words “Reusable Container - Do Not Destroy - Retain for Reuse.” NASA Critical Item Labels (Form 1368 series) shall be applied in accordance with NHB 6000.1C. (LS-71000, Section 9.4)

5.5 NASA CRITICAL SPACE ITEM LABEL

The NASA Critical Space Item Labels Form 1368 shall be affixed to exterior and interior shipping containers in accordance with NHB 6000.1C. (LS-71000, Section 9.5A)

6.0 NOTES

This section contains information of a general or explanatory nature that may be helpful but is not mandatory.

6.1 DEFINITIONS

Qualification Test	Test conducted as part of the certification program to demonstrate that the design and performance requirements can be realized under specified conditions.
Acceptance Test	Formal tests conducted to assure that the end item meets specified requirements. Acceptance tests include performance demonstrations and environmental exposures to screen out manufacturing defects, workmanship errors, incipient failures, and other performance anomalies not readily detectable by normal inspection techniques or through ambient functional tests.
Active Air Exchange	Forced convection between two volumes. For example, forced convection between a subrack payload and the internal volume of an integrated rack, or forced convection between a subrack payload and cabin air.
Continuous Noise Source	A significant noise source, which exists for a cumulative total of eight hours or more in any 24-hour period is considered to be a continuous noise source.
Intermittent Noise Source	A significant noise source, which exists for a cumulative total of less than eight hours in a 24-hour period is considered to be an intermittent noise source.
On-Orbit Momentary Protrusions	Payload obstructions that typically would protrude for a very short time or could be readily eliminated by the crew at any time. Momentary protrusions include only the following: drawers/door/cover replacements or closures.)
On-Orbit Permanent Protrusions	A payload hardware item that is not ever intended to be removed.
On-Orbit Semi-Permanent Protrusions	A payload hardware item that is typically left in place, but can be removed by the crew with hand operations or standard IVA tools. Example: SIR and ISIS drawer handles, other equipment that does not interfere with crew restraints and mobility aids.
On-Orbit Temporary Protrusions	A payload item that is typically located in the aisle for experiment purposes only. These items should be returned to their stowed configuration when not being used. Example: Front panel mounted equipment.

APPENDIX A

RESERVED

APPENDIX B

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

APPENDIX B

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SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.2.2.2.2.1A	6.3.1.5A	3.1.1.7A	On-Orbit Payload Protrusions - lateral protrusions	E	Per ICD		Exception – deployed near treadmill in Russian segment
3.2.2.2.2.1B	6.3.1.5B	3.1.1.7B	On-Orbit Payload Protrusions - seat track obstruction	E	Per ICD		Exception – deployed near treadmill in Russian segment
3.2.2.2.2.1.1	6.3.1.5.1	3.1.1.7.1	On-Orbit Permanent Protrusions	N/A	Per ICD		No permanent protrusions
3.2.2.2.2.1.2A	6.3.1.5.2B	3.1.1.7.2B	On-Orbit Semi-Permanent Protrusions – envelope	N/A	Per ICD		No semi-permanent protrusions
3.2.2.2.2.1.2B	6.3.1.5.2C	3.1.1.7.2C	On-Orbit Semi-Permanent Protrusions - easily removable	N/A	Per ICD		No semi-permanent protrusions
3.2.2.2.2.1.3A	6.3.1.5.3A	3.1.1.7.3A	On-Orbit Temporary Protrusions – envelope	E	Per ICD		Exception – deployed in Russian segment
3.2.2.2.2.1.3B	6.3.1.5.3B	3.1.1.7.3B	On-Orbit Temporary Protrusions - stow time	E	Per ICD		Exception – deployed in Russian segment
3.2.2.2.2.1.4	6.3.1.5.4	3.1.1.7.4	On-Orbit Momentary Protrusions	N/A	Per ICD		No momentary protrusions
3.2.4A	6.4.4.2.6.3	3.12.4.2.8.4	Maintainability - Unique Tools	N/A	Per ICD		No unique tools
3.2.4B	6.4.4.3.1	3.12.4.3.1	Maintainability - One-handed Operation	N/A	Per ICD		No ORUs
3.2.4C	6.4.4.3.2B	3.12.4.3.2A2	Maintainability - Connector Mate/Demate	N/A	Per ICD		No planned maintenance
3.2.4D	6.4.4.3.2C	3.12.4.3.2B	Maintainability - No Damage to Wiring Connectors	✓	Per ICD		
3.2.4E	6.4.4.2.6	3.12.4.2.8	Maintainability - Access to Hardware Items	N/A	Per ICD		No planned maintenance

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

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SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.2.4F	6.4.3.1.2A	3.12.3.1.2A	Maintainability - Built-in Control	N/A	Per ICD		Does not contain liquids or particulates
3.2.4G	6.4.3.1.2B	3.12.3.1.2B	Maintainability - Access to Filters for Replacement/Cleaning	✓	Per ICD		
3.2.4.1.1	6.4.10	3.12.10	Payload In-flight Maintenance	N/A	Per ICD		No planned maintenance
3.2.5.1.1.1	6.3.7.1.1	3.9.1.1	Pressure	✓	Per ICD		
3.2.5.1.1.2	6.3.7.1.2	3.9.1.2	Temperature	✓	Per ICD		
3.2.5.1.1.3	6.3.7.1.3	3.9.1.3	Humidity	N/A	Per ICD		No cooling below ambient
3.2.5.1.2.1	6.3.7.2.1	3.9.2.1A	Active Air Exchange	N/A	Per ICD		No active air exchange
3.2.5.1.2.2	6.3.7.2.2	3.9.2.2	Oxygen Consumption	N/A	Per ICD		Does not consume oxygen
3.2.5.1.2.3	6.3.7.2.3	3.9.2.3	Chemical Releases	✓	Per ICD		
3.2.5.1.3.1	6.3.7.3.1	3.9.3.1	Instrument Contained or Generated Ionizing Radiation	✓	Per ICD		
3.2.5.1.3.3	6.3.7.3.3	3.9.3.3	Single Event Effect (SEE) Ionizing Radiation	✓	Per ICD		
3.2.5.1.3.4	6.3.7.3.4	3.9.3.4	Lab Window Rack Location Radiation Requirements	N/A	Per ICD		Not in a nadir window location
3.2.5.1.3.4.1	6.3.7.3.4.1	3.9.3.4.1	Window Rack Infrared Radiation Requirements	N/A	Per ICD		Not in a nadir window location
3.2.5.1.3.4.2	6.3.7.3.4.2	3.9.3.4.2	Window Rack Ultraviolet Radiation Requirements	N/A	Per ICD		Not in a nadir window location
3.2.5.1.5A	6.3.1.2B	3.1.1.4B	Pressure Rate of Change - On-orbit	✓	Per ICD		
3.2.5.1.5C1	6.3.1.2A	3.1.1.2B	Pressure Rate of Change – MPLM	✓	Per ICD		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

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SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.2.5.1.5D	6.3.1.2C	3.1.1.4K	Pressure Rate of Change – PFE	N/A	Per ICD		No PFE port
3.2.5.1.6.1		3.1.2.1	Quasi-Steady Requirements	✓	Per ICD		
3.2.5.1.6.2		3.1.2.2	Vibratory Requirements	✓	Per ICD		
3.2.5.1.6.3A		3.1.2.3A	Transient Requirements	✓	Per ICD		
3.2.5.1.6.3B		3.1.2.3B	Transient Requirements	✓	Per ICD		
3.2.5.2.1	6.4.3.3.1C	3.12.3.3.1C	Continuous Noise Limits	✓	Per ICD		
3.2.5.2.2A	6.4.3.3.2A	3.12.3.3.2	Intermittent Noise Limits - A-weighted SPL Limits	✓	Per ICD		
3.2.5.2.2B	6.4.3.3.2	3.12.3.3.2	Intermittent Noise Limits - Cumulative Duration	✓	Per ICD		
3.2.7.1.1	6.3.1.6.1	3.1.1.6.1	Connector Physical Mate	N/A	Per ICD		Only interfaces to Russian power
3.2.7.2.1.1	6.3.2.4	3.2.4	Electromagnetic Compatibility (EMC)	N/A	Per ICD		Uses Russian power
3.2.7.2.1.1.1	6.3.2.4.1	3.2.4.1	Electrical Grounding	✓	Per ICD		
3.2.7.2.1.1.2	6.3.2.4.2	3.2.4.2	Electrical Bonding	✓	Per ICD		
3.2.7.2.1.2A	6.3.2.4.4	3.2.4.4	Electromagnetic Interference	N/A	Per ICD		Used in Russian segment
3.2.7.2.1.2B	6.3.2.4.4	3.2.4.4	Electromagnetic Interference - Alternative Use of RS03PL	N/A	Per ICD		Used in Russian segment
3.2.7.2.2A	6.3.2.5	3.2.4.5	ESD ≤ 4000V	✓	Per ICD		
3.2.7.2.2B	6.3.2.5	3.2.4.5	ESD between 4000V and 15000V - Labeling EPCE	✓	Per ICD		
3.2.7.2.2C	6.3.2.5	3.2.4.5	ESD Labeling	✓	Per ICD		
3.2.7.2.3	6.3.2.8	3.2.4.8	Corona	✓	Per ICD		
3.2.7.2.4	6.3.2.4.3	3.2.4.3	Cable/Wire Design and Control Requirements	✓	Per ICD		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX B (Cont'd)

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SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.2.7.2.4.1B	6.3.2.1B	3.2.3.1B	Wire Derating	✓	Per ICD		
3.2.7.2.4.2	6.3.2.2	3.2.3.2B	Exclusive Power Feeds	N/A	Per ICD		Uses Russian power
3.2.7.2.5	6.3.2.3	3.2.3.3	Loss of Power	✓	Per ICD		
3.2.7.2.6	6.3.2.6	3.2.4.6	AC Magnetic Fields	✓	Per ICD		
3.2.7.2.7	6.3.2.7	3.2.4.7	DC Magnetic Fields	✓	Per ICD		
3.2.7.2.8.1	6.3.2.11.1	3.2.1.1.2	Steady State Voltage	N/A	Per ICD		Uses Russian power
3.2.7.2.8.2	6.3.2.11.2	3.2.1.2.1	Ripple Voltage and Noise	N/A	Per ICD		Uses Russian power
3.2.7.2.8.3	6.3.2.11.3	3.2.1.2.2	Ripple Voltage Spectrum	N/A	Per ICD		Uses Russian power
3.2.7.2.8.4	6.3.2.11.4	3.2.1.3.2	Transient Voltages	N/A	Per ICD		Uses Russian power
3.2.7.2.8.5	6.3.2.11.5	3.2.1.3.3	Fault Clearing and Protection	N/A	Per ICD		Uses Russian power
3.2.7.2.8.6A	6.3.2.11.6A	3.2.1.3.4A	Non-Normal Voltage Range	N/A	Per ICD		Uses Russian power
3.2.7.2.8.6B	6.3.2.11.6B	3.2.1.3.4B	Non-Normal Voltage Range	N/A	Per ICD		Uses Russian power
3.2.7.2.8.7A	6.3.2.11.7A	3.2.2.1E	UOP Connectors and Pin Assignments	N/A	Per ICD		Uses Russian power
3.2.7.2.8.7B	6.3.2.11.7B	3.2.2.1E	UOP Connectors and Pin Assignments	N/A	Per ICD		Uses Russian power
3.2.7.2.8.7C	6.3.2.11.7C	3.2.2.1F	UOP Connectors and Pin Assignments	N/A	Per ICD		Uses Russian power
3.2.7.2.8.7D	6.3.2.11.7D	3.2.2.1F	UOP Connectors and Pin Assignments	N/A	Per ICD		Uses Russian power
3.2.7.2.8.8	6.3.2.11.8	3.2.2.3	Compatibility with Soft Start/Stop RPC	N/A	Per ICD		Uses Russian power
3.2.7.2.8.9	6.3.2.11.9	3.2.2.4	Surge Current	N/A	Per ICD		Uses Russian power
3.2.7.2.8.10	6.3.2.11.10	3.2.2.5	Reverse Energy/Current	N/A	Per ICD		Uses Russian power
3.2.7.2.8.11A	6.3.2.11.11A	3.2.2.6.1.1C	Remote Power Controllers	N/A	Per ICD		Uses Russian power
3.2.7.2.8.11B	6.3.2.11.11B	3.2.2.6.1.1D	Remote Power Controllers	N/A	Per ICD		Uses Russian power

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX B (Cont'd)

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.2.7.2.8.12A	6.3.2.11.12	3.2.2.8	Large Signal Stability	N/A	Per ICD		Uses Russian power
3.2.7.2.8.12B	6.3.2.11.12	3.2.2.8	Large Signal Stability	N/A	Per ICD		Uses Russian power
3.2.7.2.8.13	6.3.2.11.13	3.2.2.9	Maximum Ripple Voltage Emissions	N/A	Per ICD		Uses Russian power
3.2.7.2.8.14A	6.3.2.11.14A	3.2.2.10A	Electrical Load Stand Alone Stability	N/A	Per ICD		Uses Russian power
3.2.7.2.8.14B	6.3.2.11.14B	3.2.2.10B	Electrical Load Stand Alone Stability	N/A	Per ICD		Uses Russian power
3.2.7.2.8.14C	6.3.2.11.14C	3.2.2.10C	Electrical Load Stand Alone Stability	N/A	Per ICD		Uses Russian power
3.2.7.4.1	6.3.8.1	3.10.1	Fire Prevention	✓	Per ICD		
3.2.7.4.2.1A	6.3.8.2.1A	3.10.3.1A	PFE - Small Access Port	N/A	Per ICD		No PFE port
3.2.7.4.2.1B	6.3.8.2.1B	3.10.3.1B	PFE - Large Access Port	N/A	Per ICD		No PFE port
3.2.7.4.2.2	6.3.8.2.2	3.10.3.2	Fire Suppression Access Port Accessibility	N/A	Per ICD		No PFE port
3.2.7.4.2.3	6.3.8.2.3	3.10.3.3	Fire Suppressant Distribution	N/A	Per ICD		No PFE port
3.2.7.4.3	6.3.8.3	3.10.4A	Labeling	N/A	Per ICD		No PFE port
3.2.7.5.14		3.12.3.4.A	Lighting Design	✓	Per ICD		
3.2.7.5.15	6.1.2.23	3.2.4.9	Lightning	✓	Per ICD		
3.2.7.5.16	6.4.3.4	3.12.8	Color	✓	Per ICD		
3.3.1.1A	6.3.9.1	3.11.1	Materials and Processes	✓	Per ICD		
3.3.1.1B	6.3.9.2	3.11.1.1	Materials and Processes - Commercial Parts	✓	Per ICD		
3.3.1.1C	6.3.9.3	3.11.3	Materials and Processes – Cleanliness	✓	Per ICD		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX B (Cont'd)

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.3.1.1E	6.3.9.4	3.11.4	Materials and Processes - Fungus Resistant Materials	✓	Per ICD		
3.3.1.2	6.4.9.2	3.12.9.2	Sharp Edges and Corner Protection	✓	Per ICD		
3.3.1.3	6.4.9.3	3.12.9.3	Holes	✓	Per ICD		
3.3.1.4	6.4.9.4	3.12.9.4	Latches	✓	Per ICD		
3.3.1.5	6.4.9.5	3.12.9.5	Screws and Bolts	✓	Per ICD		
3.3.1.6	6.4.9.6	3.12.9.6	Securing Pins	✓	Per ICD		
3.3.1.7	6.4.9.7	3.12.9.7	Levers, Cranks, Hooks, and Controls	✓	Per ICD		
3.3.1.8	6.4.9.8	3.12.9.8	Burrs	✓	Per ICD		
3.3.1.9A	6.4.9.9A	3.12.9.9A	Locking Wires	✓	Per ICD		
3.3.1.9B	6.4.9.9B	3.12.9.9B	Locking Wires - Safety Cabling or Cotter Pinning	✓	Per ICD		
3.3.2.1	6.4.7	3.12.7	Equipment Identification	✓	Per ICD		
3.3.5.1.1A	6.3.2.10.1	3.2.5.1.1	Mating/Demating of Powered Connectors	✓	Per ICD		
3.3.5.1.2A	6.3.2.10.3A	3.2.5.3A	Power Switches/Controls - Open Supply Circuit Conductors	✓	Per ICD		
3.3.5.1.2B	6.3.2.10.3B	3.2.5.3B	Power Switches/Controls - Power-off Markings/Indications	✓	Per ICD		
3.3.5.1.2C	6.3.2.10.3C	3.2.5.3C	Power Switches/Controls - Supply Circuit not Completely Disconnected	✓	Per ICD		
3.3.5.1.3A	6.3.2.10.4A	3.2.5.4A	GFCI - Output Voltages > 30 V rms	N/A	Per ICD		No output voltages exceeding 30V rms or DC nominal

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX B (Cont'd)

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.3.5.1.3B	6.3.2.10.4B	3.2.5.4B	GFCI - DC Detection Independent of Safety Wire	N/A	Per ICD		No output voltages exceeding 30V rms or DC nominal
3.3.5.1.3C	6.3.2.10.4C	3.2.5.4C	GFCI - AC Detection Dependent on Safety Wire	N/A	Per ICD		No output voltages exceeding 30V rms or DC nominal
3.3.5.1.3D	6.3.2.10.4D	3.2.5.4D	GFCI - EUE Generating Internal Voltages > 30 V rms	N/A	Per ICD		No output voltages exceeding 30V rms or DC nominal
3.3.5.1.3E	6.3.2.10.4E	3.2.5.4E	GFCI - Trip Current	N/A	Per ICD		No output voltages exceeding 30V rms or DC nominal
3.3.5.1.3F	6.3.2.10.4F	3.2.5.4F	GFCI - Power Removal Time	N/A	Per ICD		No output voltages exceeding 30V rms or DC nominal
3.3.5.1.3G	6.3.2.10.4G	3.2.5.4G	GFCI - On-Orbit Testing	N/A	Per ICD		No output voltages exceeding 30V rms or DC nominal
3.3.5.1.4A	6.3.2.10.5A	3.2.5.5A	Portable Equipment/Power Cords - Non-battery Powered Portable EUE	✓	Per ICD		
3.3.5.1.4B	6.3.2.10.5B	3.2.5.5B	Portable Equipment/Power Cords - Fault Currents	N/A	Per ICD		No credible fault path to crewmember
3.3.6.1	6.4.3.1.1	3.12.3.1.1	Closures or Covers Design Requirements	✓	Per ICD		
3.3.6.3A	6.4.2.3	3.12.2.3	Full Size Range Accommodation	✓	Per ICD		
3.3.6.4A	6.4.1.1A	3.12.1A1	Grip Strength	✓	Per ICD		
3.3.6.4B	6.4.1.1B	3.12.1A2	Linear Forces	✓	Per ICD		
3.3.6.4C	6.4.1.1C	3.12.1A3	Torque	✓	Per ICD		
3.3.6.5	6.4.1.2	3.12.1B	Maintenance Operations	N/A	Per ICD		No planned maintenance
3.3.6.6	6.4.2.1	3.12.2.1	Adequate Clearance	N/A	Per ICD		See 3.3.6.7A
3.3.6.7A	6.4.2.2A	3.12.2.2A	Accessibility - Geometric Arrangement	✓	Per ICD		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX B (Cont'd)

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.3.6.7B	6.4.2.2B	3.12.2.2B	Accessibility - Access Openings for Fingers	✓	Per ICD		
3.3.6.8	6.4.3.1.3	3.12.3.1.5	One-Handed Operation	N/A	Per ICD		No cleaning equipment, etc.
3.3.6.9	6.4.3.2.1	3.12.3.2.1	Continuous/Incidental Contact - High Temperature	✓	Per ICD		
3.3.6.10	6.4.3.2.2	3.12.3.2.2	Continuous/Incidental Contact - Low Temperature	N/A	Per ICD		No low temperatures
3.3.6.11	6.4.4.2.1	3.12.4.2.1	Equipment Mounting	✓	Per ICD		
3.3.6.12A	6.4.4.2.2A	3.12.4.2.2	Drawers and Hinged Panels - for routine checkout of P/L ORUs	N/A	Per ICD		No ORUs
3.3.6.12B	6.4.4.2.2B	3.12.4.2.2	Drawers and Hinged Panels - remain open without manual support	N/A	Per ICD		No ORUs
3.3.6.13	6.4.4.2.3	3.12.4.2.5	Alignment	✓	Per ICD		
3.3.6.14	6.4.4.2.5	3.12.4.2.7	Push-Pull Force	N/A	Per ICD		No push-pull force
3.3.6.15A	6.4.4.2.6.1A	3.12.4.2.8.1A	Covers - sliding or hinged cap or door	N/A	Per ICD		No physical access
3.3.6.15B	6.4.4.2.6.1B	3.12.4.2.8.1B	Covers - quick-opening cover plate	N/A	Per ICD		No physical access
3.3.6.16	6.4.4.2.6.2	3.12.4.2.8.2	Self-Supporting Covers	N/A	Per ICD		No physical access
3.3.6.17	6.4.4.3.2A	3.12.4.3.2A1	Accessibility	✓	Per ICD		
3.3.6.18A	6.4.4.3.3A	3.12.4.3.3A	Ease of Disconnect - nominal operations	✓	Per ICD		
3.3.6.18B	6.4.4.3.3B	3.12.4.3.3B	Ease of Disconnect - ORU replacement operations	N/A	Per ICD		No ORUs
3.3.6.19	6.4.4.3.5	3.12.4.3.5	Self Locking	✓	Per ICD		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX B (Cont'd)

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.3.6.20A	6.4.4.3.6A	3.12.4.3.6A	Connector Arrangement - Space between Connectors and Adjacent Obstructions	✓	Per ICD		
3.3.6.20B	6.4.4.3.6B	3.12.4.3.6B	Connector Arrangement - Space between Connectors in a Row	✓	Per ICD		
3.3.6.21	6.4.4.3.7	3.12.4.3.7	Arc Containment	✓	Per ICD		
3.3.6.22	6.4.4.3.8	3.12.4.3.8	Connector Protection	✓	Per ICD		
3.3.6.23	6.4.4.3.9	3.12.4.3.9	Connector Shape	✓	Per ICD		
3.3.6.24	6.4.4.3.11A	3.12.4.3.11A	Alignment Marks or Guide Pins	✓	Per ICD		
3.3.6.25A	6.4.4.3.12A	3.12.4.3.12A	Coding - Unique to Connection	✓	Per ICD		
3.3.6.25B	6.4.4.3.12B	3.12.4.3.12B	Coding - Visible	✓	Per ICD		
3.3.6.26	6.4.4.3.13	3.12.4.3.13	Pin Identification	✓	Per ICD		
3.3.6.27	6.4.4.3.14	3.12.4.3.14	Orientation	✓	Per ICD		
3.3.6.28A	6.4.4.3.15A	3.12.4.3.15A	Hose/Cable Restraints - Loose Ends	N/A	Per ICD		Not a Rack
3.3.6.28B	6.4.4.3.15B	3.12.4.3.15B	Hose/Cable Restraints - Clamps	N/A	Per ICD		Not a Rack
3.3.6.28D	6.4.4.3.15D	3.12.4.3.15D	Hose/Cable Restraints - Lengths	✓	Per ICD		
3.3.6.29	6.4.4.4.1	3.12.4.4.1	Non-Threaded Fasteners Status Indication	✓	Per ICD		
3.3.6.30	6.4.4.4.2	3.12.4.4.2	Mounting Bolt/Fastener Spacing	✓	Per ICD		
3.3.6.31	6.4.4.4.3	3.12.4.4.4A	Multiple Fasteners	✓	Per ICD		
3.3.6.32	6.4.4.4.4	3.12.4.4.5	Captive Fasteners	✓	Per ICD		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX B (Cont'd)

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.3.6.33A	6.4.4.4.5A	3.12.4.4.6A	Quick Release Fasteners - One turn max	✓	Per ICD		
3.3.6.33B	6.4.4.4.5B	3.12.4.4.6B	Quick Release Fasteners - Positive Locking	✓	Per ICD		
3.3.6.34	6.4.4.4.6	3.12.4.4.7	Threaded Fasteners	✓	Per ICD		
3.3.6.35A	6.4.4.4.7A	3.12.4.4.8A	Over Center Latches - Nonself-latching	N/A	Per ICD		No over-center latches
3.3.6.35B	6.4.4.4.7B	3.12.4.4.8B	Over Center Latches - Latch Lock	N/A	Per ICD		No over-center latches
3.3.6.35C	6.4.4.4.7C	3.12.4.4.8C	Over Center Latches - Latch Handles	N/A	Per ICD		No over-center latches
3.3.6.36	6.4.4.4.8	3.12.4.4.9	Winghead Fasteners	N/A	Per ICD		No winghead fasteners
3.3.6.37A	6.4.4.4.9A	3.12.4.4.11A	Fastener Head Type - On-Orbit Crew Actuation	N/A	Per ICD		No planned crew actuation
3.3.6.37B	6.4.4.4.9B	3.12.4.4.11B	Fastener Head Type - Smooth Surface	N/A	Per ICD		No planned crew actuation
3.3.6.37C	6.4.4.4.9C	3.12.4.4.11C	Fastener Head Type - Slotted Fasteners	N/A	Per ICD		Not mounted during launch
3.3.6.38	6.4.4.4.10	3.12.4.4.12	One-Handed Actuation	N/A	Per ICD		No planned actuation
3.3.6.40	6.4.4.4.12	3.12.4.4.14	Access Holes	✓	Per ICD		
3.3.6.41	6.4.5.1	3.12.5.1	Controls Spacing Design Requirements	✓	Per ICD		
3.3.6.42	6.4.5.2.1	3.12.5.2.1	Protective Methods - Location/Orientation	✓	Per ICD		
3.3.6.43	6.4.5.2.2	3.12.5.2.2	Noninterference	✓	Per ICD		
3.3.6.44	6.4.5.2.3	3.12.5.2.3	Dead-Man Controls	N/A	Per ICD		
3.3.6.45	6.4.5.2.4	3.12.5.2.4	Barrier Guards	✓	Per ICD		
3.3.6.46	6.4.5.2.5	3.12.5.2.5	Recessed Switch Protection	N/A	Per ICD		No critical functions

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX B (Cont'd)

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.3.6.47	6.4.5.2.7	3.12.5.2.7	Position Indication	N/A	Per ICD		No switch protective covers
3.3.6.48	6.4.5.2.8	3.12.5.2.8	Hidden Controls	N/A	Per ICD		No hidden controls
3.3.6.49	6.4.5.2.9	3.12.5.2.9	Hand Controllers	N/A	Per ICD		No hand controllers
3.3.6.50A	6.4.5.3A	3.12.5.3A	Valve Controls - Low-Torque Valves	N/A	Per ICD		No valve controls
3.3.6.50B	6.4.5.3B	3.12.5.3B	Valve Controls - Intermediate-Torque Valves	N/A	Per ICD		No valve controls
3.3.6.50C	6.4.5.3C	3.12.5.3C	Valve Controls - High-Torque Valves	N/A	Per ICD		No valve controls
3.3.6.50D	6.4.5.3D	3.12.5.3D	Valve Controls - Handle Dimensions	N/A	Per ICD		No valve controls
3.3.6.50E	6.4.5.3E	3.12.5.3E	Valve Controls - Rotary Valve Controls	N/A	Per ICD		No valve controls
3.3.6.51	6.4.5.4	3.12.5.4	Toggle Switches	✓	Per ICD		
3.3.6.52	6.4.6	3.12.6	Restraints and Mobility Aids	✓	Per ICD		
3.3.6.54	6.4.6.3	3.12.6.3	Captive Parts	✓	Per ICD		
3.3.6.55	6.4.6.4.1	3.12.6.4.1	Handles and Restraints	✓	Per ICD		
3.3.6.56	6.4.6.4.2	3.12.6.4.3	Handle Location/Front Access	✓	Per ICD		
3.3.6.57	6.4.6.4.3	3.12.6.4.4	Handle Dimensions	✓	Per ICD		
3.3.6.58A	6.4.6.4.4A	3.12.6.4.5A	Non-Fixed Handles Design Requirements - Stop Position	N/A	Per ICD		No non-fixed handles
3.3.6.58B	6.4.6.4.4B	3.12.6.4.5B	Non-Fixed Handles Design Requirements - One Hand Use	N/A	Per ICD		No non-fixed handles
3.3.6.58C	6.4.6.4.4C	3.12.6.4.5C	Non-Fixed Handles Design Requirements - Locked/Unlocked Indication	N/A	Per ICD		No non-fixed handles

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX B (Cont'd)

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.3.6.59B	6.4.9.1B	3.12.9.1B	Electrical Hazards - Exposure hazard exceeds threshold for shock	✓	Per ICD		
3.3.6.59C	6.4.9.1C	3.12.9.1C	Electrical Hazards - Exposure hazard exceeds threshold for shock and threshold of let-go profile	✓	Per ICD		
3.3.6.59D	6.4.9.1D	3.12.9.1D	Electrical Hazards -Two dependent controls provided	✓	Per ICD		
3.3.6.59E	6.4.9.1E	3.12.9.1E	Electrical Hazards -Three independent hazard controls	✓	Per ICD		
3.3.6.60A	6.4.9.1.1A	3.12.9.1.1	Mismatched - Reversed Connection	✓	Per ICD		
3.3.6.60B	6.4.9.1.1B	3.12.9.1.1	Mismatched - Blind Connections	✓	Per ICD		
3.3.6.60C	6.4.9.1.1C	3.12.9.1.1	Mismatched - Mismating	✓	Per ICD		
3.3.6.60D	6.4.9.1.1D	3.12.9.1.1	Mismatched - Minimizing Equipment Risk	✓	Per ICD		
3.3.6.61	6.4.9.1.2.1	3.12.9.1.4.1	Device Accessibility	✓	Per ICD		
3.3.6.62	6.4.9.1.2.2	3.12.9.1.4.2	Extractor-Type Fuse Holder	✓	Per ICD		
3.3.6.63	6.4.9.1.2.3	3.12.9.1.4.3	Overload Protection Location	✓	Per ICD		
3.3.6.64	6.4.9.1.2.4	3.12.9.1.4.4	Overload Protection Identification	✓	Per ICD		
3.3.6.65	6.4.9.1.2.5	3.12.9.1.4.5	Automatic Restart Protection	✓	Per ICD		
3.3.6.66A	6.4.9.10A	3.12.9.10A	Audio Displays - False Alarms	N/A	Per ICD		No audible alarms
3.3.6.66B	6.4.9.10C	3.12.9.10C	Audio Displays - Operability Testing	N/A	Per ICD		No audible alarms

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX B (Cont'd)

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

SRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	Verification Method	Responsibility	Comments
3.3.6.66C	6.4.9.10D	3.12.9.10D	Audio Displays - Manual Disable	N/A	Per ICD		No audible alarms
3.3.6.67	6.4.9.11	3.12.9.12	Egress	✓	Per ICD		
3.3.8.1A.1	6.3.1.3A	3.1.1.3F	Structural Design Requirements - Positive Margins of Safety for MPLM Launch and Landing	✓	Per ICD		
3.3.8.1B	6.3.1.3B	3.1.1.3B	Structural Design Requirements - Positive Safety Margins for On-orbit Loads	✓	Per ICD		
3.3.8.1.1	6.3.1.3C	3.1.1.3D	Crew Induced Load Requirements	✓	Per ICD		
3.3.8.1.2	6.3.1.1	3.1.1.5A	Safety Critical Structures Requirements	N/A	Per ICD		No safety critical structures
3.3.8.1.3			Loads Requirements	N/A	Per ICD		Addressed in 3.3.8.1A
3.3.8.3.1	6.2.7.2	3.7.5	Pressurized Gas Bottles	N/A	Per ICD		Does not interface with any pressurized gas system
3.3.8.3.2	6.2.7.3	3.7.6	Manual Valves	N/A	Per ICD		Does not interface with any pressurized gas system

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX C

FUNCTIONAL PERFORMANCE VERIFICATION MATRIX

APPENDIX C

FUNCTIONAL PERFORMANCE VERIFICATION MATRIX

SRD Section	LS-71000 Section	Requirement	Applicable	Verification Method	Comments
3.2.1.1.1.A		Video Formats	✓	T	
3.2.1.1.1.B		Video Formats	✓	T	
3.2.1.1.1.C		Video Formats	✓	T	
3.2.1.1.2.A		Mobility Graphics Display Characteristics	✓	T	
3.2.1.1.2.B1		Mobility Graphics Display Characteristics	✓	T	
3.2.1.1.2.B2		Mobility Graphics Display Characteristics	✓	T	
3.2.1.1.2.B3		Mobility Graphics Display Characteristics	✓	T	
3.2.1.1.2.B4		Mobility Graphics Display Characteristics	✓	T	
3.2.1.1.2.C		Mobility Graphics Display Characteristics	✓	T	
3.2.1.1.3.A		Mobility Visual Acuity Display Characteristics	✓	I	
3.2.1.1.3.B		Mobility Visual Acuity Display Characteristics	✓	T	
3.2.1.1.3.C		Mobility Visual Acuity Display Characteristics	✓	A	
3.2.1.1.4.A		Audio Output Characteristics	✓	T	
3.2.1.1.4.B		Audio Output Characteristics	✓	T	
3.2.1.1.5.A		Data Storage	✓	A	
3.2.1.1.5.B		Data Storage	✓	A	
3.2.1.1.5.C		Data Storage	✓	A	
3.2.1.1.5.D		Data Storage	✓	A	
3.2.1.1.7.A		Mobility Mouse	✓	I	
3.2.1.1.7.B		Mobility Mouse	✓	I	
3.2.1.1.7.C		Mobility Mouse	✓	A	
3.2.1.1.7.D		Mobility Mouse	✓	A	

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX C

FUNCTIONAL PERFORMANCE VERIFICATION MATRIX (Cont'd)

SRD Section	LS-71000 Section	Requirement	Applicable	Verification Method	Comments
3.2.1.1.8.A		Other Electrical Interfaces	✓	I	
3.2.1.1.8.B		Other Electrical Interfaces	✓	I	
3.2.1.1.9.A		Processor Memory Requirements	✓	A	
3.2.1.1.9.B		Processor Memory Requirements	✓	A	
3.2.1.1.9.C		Processor Memory Requirements	✓	A	
3.2.1.1.9.D		Processor Memory Requirements	✓	A	
3.2.1.1.9.E		Processor Memory Requirements	✓	A	
3.2.1.1.9.F		Processor Memory Requirements	✓	A	
3.2.1.1.10.A		Boot Method	✓	T	
3.2.1.1.10.B		Boot Method	✓	T	
3.2.1.1.11.A		Software Navigation	✓	T	
3.2.1.1.11.B		Software Navigation	✓	T	
3.2.1.1.11.C		Software Navigation	✓	T	
3.2.1.1.12.B		Structural and Power Interface	✓	T	
3.2.1.1.12.C		Structural and Power Interface	✓	T	
3.2.1.1.12.D1		Structural and Power Interface	✓	A	
3.2.1.1.12.D2		Structural and Power Interface	✓	A	
3.2.2.1		Mass Properties	✓	T	
3.2.2.2.1		Stowed Envelope	✓	I	
3.2.3A	7.2	Reliability, Quality, and Non-Conformance Reporting	N/A		Reliability requirements defined directly in the SRD.
3.2.3B	7.3.1	Reliability, Quality, and Non-Conformance Reporting	✓	A	

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX C

FUNCTIONAL PERFORMANCE VERIFICATION MATRIX (Cont'd)

SRD Section	LS-71000 Section	Requirement	Applicable	Verification Method	Comments
3.2.3C1	7.3.2(1)	Reliability, Quality, and Non-Conformance Reporting	✓	A	
3.2.3C2	7.3.2(2)	Reliability, Quality, and Non-Conformance Reporting	✓	A	
3.2.3C3	7.3.2(3)	Reliability, Quality, and Non-Conformance Reporting	✓	A	
3.2.3C4	7.3.2(4)	Reliability, Quality, and Non-Conformance Reporting	✓	A	
3.2.3.1		Failure Propagation	✓	A	
3.2.3.2	3.1.1	Useful Life	✓	A	
3.2.5.1.5C2	6.3.1.2A	Pressure Rate of Change - Carrier (Orbiter)	✓	A	
3.2.6.1	6.3.1.3	Launch and Landing	✓	A	
3.3.1.1F		Materials and Processes	✓	A	
3.3.1.1G		Materials and Processes	✓	I	
3.3.1.9C		Locking Wires	✓	I	
3.3.3	7.3.1	Workmanship	✓	A	
3.3.5.1.1B		Mating/Demating of Powered Connectors	✓	A	
3.3.6.2.1A	6.4.3.5.1	Rack Mounted Equipment - Color	N/A		Not a drawer
3.3.6.2.1B	6.4.3.5.1	Rack Mounted Equipment - Finish	N/A		Not a drawer
3.3.6.2.1C	6.4.3.5.1	Rack Mounted Equipment - SIR Drawer Panel Handle Latches - Finish	N/A		No drawer handles/latches
3.3.6.2.2A	6.4.3.5.2A	Stowed/Deployable Equipment - COTS Equipment Non-repackaged - Finish	✓	I	
3.3.6.2.2B	6.4.3.5.2B	Stowed/Deployable Equipment - COTS Equipment Repackaged - Finish	✓	I	
3.3.6.3B		Full Size Range Accommodation - COTS Equipment	✓	A	

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX C

FUNCTIONAL PERFORMANCE VERIFICATION MATRIX (Cont'd)

SRD Section	LS-71000 Section	Requirement	Applicable	Verification Method	Comments
3.3.8.1A2	6.3.1.3A	Structural Design Requirements - Orbiter Loading Middeck Launch and Landing	✓	A	
3.3.8.2.1	6.3.2.10	Batteries	✓	A	

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX D

ACCEPTANCE AND QUALIFICATION TEST APPLICABILITY MATRICES

APPENDIX D

TABLE D-1. ACCEPTANCE AND QUALIFICATION TEST APPLICABILITY MATRIX

SRD Section	LS-71000 Section	Requirement	Applicable	SRD Verification Section
3.4.1A	5.4.1.1.6.1 and 5.4.1.1.6.2	Thermal Environment Compatibility	✓	4.3.1.1, 4.3.1.2
3.4.1B	5.4.1.1.6.1 and 5.4.1.1.6.2	THERMAL ENVIRONMENT COMPATIBILITY	✓	4.3.1.1, 4.3.1.2
3.4.2	5.4.1.1.3.2 and 5.4.1.1.3.3	Workmanship Vibration	E	4.3.2.1, 4.3.2.2
3.4.3	5.4.1.3.4	Functional Performance	✓	4.3.3
3.4.4	5.4.1.1.10	EEE Parts Control, Selection, and Burn-in	✓	4.3.4
3.4.5	5.4.1.1.8	Flammability	✓	4.3.5
3.4.6	5.4.1.1.9	Offgassing	✓	4.3.6
3.4.7	5.4.1.1.5	Bench Handling	✓	4.3.7
3.4.8	5.4.1.1.1	Payload Mass	✓	4.3.8
3.4.9	5.4.1.2.1	Electromagnetic Compatibility	✓	4.3.9
3.4.10	5.4.1.1.7	Acoustic Noise	✓	4.3.10
3.4.11	5.4.1.3.1	Software Acceptance	N/A	4.3.11
3.4.12	5.4.1.3.2	Pre-Delivery Acceptance	✓	4.3.12

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

TABLE D-2. NON-CRITICAL HARDWARE QUALIFICATION TEST REQUIREMENTS

Component / Type Test	Mobility Hardware							
Thermal Cycling 7.5 Cycles	✓							
Qualification for Acceptance Vibration	N/A							
Flammability	✓							
Offgassing	✓							
Bench Handling	✓							
Payload Mass Control Plan	✓							
EMI/EMC Control Plan	✓							
ACOUSTIC NOISE CONTROL PLAN	✓							
EEE PARTS SCREENING	✓							
EEE Parts Control	✓							

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

TABLE D-3. NON-CRITICAL HARDWRE ACCEPTANCE TEST REQUIREMENTS

Component / Type Test	Mobility Hardware							
Thermal Cycling 1½ Cycles	✓							
Acceptance Vibration	E							
Functional	✓							
Burn-in	✓							
Pre-Delivery Acceptance Functional	✓							

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX E

ISS RUSSIAN SEGMENT VERIFICATION MATRIX

APPENDIX E

ISS RUSSIAN SEGMENT VERIFICATION MATRIX

SRD Section	SSP50094	Requirement	Applicability	Verification Method
3.2.7.5.1.A	3.4.1.1.1	Russian Segment Low Frequency Conducted Emissions	✓	Test and Analysis
3.2.7.5.1.B	3.4.1.1.1	Russian Segment Low Frequency Conducted Emissions	✓	Test and Analysis
3.2.7.5.2	3.4.1.1.2	Russian Segment Radio Frequency Conducted Emissions	✓	Test and Analysis
3.2.7.5.3	3.4.1.1.3	Russian Segment Radio Frequency Radiated Emissions	✓	Test and Analysis
3.2.7.5.4	3.4.1.2.1	Russian Segment Low Frequency Conducted Susceptibility	✓	Test and Analysis
3.2.7.5.5	3.4.1.2.2	Russian Segment Radio Frequency Conducted Susceptibility	✓	Test and Analysis
3.2.7.5.6.A	3.4.1.3.1b	Russian Segment Pulse Conducted Susceptibility	✓	Test and Analysis
3.2.7.5.6.B	3.4.1.2.3	Russian Segment Pulse Conducted Susceptibility	✓	Test and Analysis
3.2.7.5.6.C	3.4.1.2.3	Russian Segment Pulse Conducted Susceptibility	✓	Test and Analysis
3.2.7.5.6.D	3.4.1.2.3	Russian Segment Pulse Conducted Susceptibility	✓	Test and Analysis
3.2.7.5.7	3.4.1.2.4	Russian Segment Magnetic Susceptibility	✓	Test and Analysis
3.2.7.5.8	3.4.1.2.4	Russian Segment Radiated Susceptibility	✓	Test and Analysis
3.2.7.5.9	3.4.1.3.1c	Cable Voltage Drop	✓	Test and Analysis
3.2.7.5.10	3.4.1.4.2	Surge Current	✓	Test and Analysis
3.2.7.5.11	3.4.1.5.1	Electrical Insulation Resistance	✓	Test and Analysis
3.2.7.5.12	3.4.1.5.2	Exclusion of Electrical Insulation Rupture	✓	Test and Analysis
3.2.7.5.13	(-106) 4.1.1.7B	Stability	✓	Test and Analysis

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